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OF THE

KANSAS ACADEMY OF SCIENCE,

FOR

1879-80.

EDITED BY THE SECRETARY.

VOL. VII.

TOPEKA, KANSAS:
GEO. W. MARTIN, KANSAS PUBLISHING HOUSE.
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REPORT.

THE TWELFTH ANNUAL MEETING.

welfth annual meeting of the Kansas Academy of Science was held
a, opening on the afternoon of Thursday, November 6th, 1879, and
g the evening of the 6th and the whole of the 7th.

ecturers chosen were Prof. B. F. Mudge, who spoke upon the "Mound
of North America," and Prof. J. H. Canfield, whose theme was,
elation of the State to Higher Education."

ession of Friday, the 7th, was given to the reading and discussion of
ers on the following programme:

ions to the Catalogue of Kansas Lepidoptera—Prof. F. H. Snow.
f Kansas Minerals—Prof. B. F. Mudge.
ds of Southern Kansas—Joseph Savage.
t Additions to the List of Kansas Plants—Prof. J. H. Carruth.
Meteorites—Prof. G. E. Patrick.
tic Representations of Indian Language—Hon. F. G. Adams.
on Kansas Botany—E. A. Popenoe.
Recent Indian Find near Topeka—Dr. A. H. Thompson.
morphic Deposit in Woodson County—Prof. B. F. Mudge.
essions of New Mexico—J. C. Cooper.
nological Collections Made at Idaho Springs, Colorado, in 1879—Prof. F. H.

Holes in Wabaunsee County—Joseph Savage.
sian Limestone in Kansas—Prof. G. E. Patrick.
ntary Sounds of Language—Prof. J. H. Carruth.
d Builders in Davis and Riley Counties—Prof. B. F.

fficers elected for the year 1880 were:
dent—B. F. Mudge, of Manhattan.
Presidents—J. H. Carruth, of Lawrence; of I

tary—E. A. Popenoe, of Manhattan.
urer—R. J. Brown, of Leavenworth.
members of (of last year were

THE THIRTEENTH ANNUAL MEETING.

The thirteenth annual meeting of the Academy was held at Topeka, November 11th, 12th, and the forenoon of November 13th, 1880.

The popular lecture of the evening of the 11th was delivered by President George T. Fairchild, of the State Agricultural College, whose subject was, "Science in Every-day Life."

The lecture of the following evening was by Prof. J. T. Lovewell, of Washburn College, Topeka, upon "Science in Schools." This lecture was followed by a paper by Col. T. L. Case, of Kansas City, describing the "Ruins of the City of Pécos, New Mexico."

The sessions of Friday, and the forenoon of Saturday, were devoted to the programme given below:

The Fossils of the Judith River Group—Chas. Sternberg.
Description of the North American Species of Conops—Dr. S. W. Williston.
Glacial Scratches—Dr. W. S. Newlon.
Tornadoes of May 30, 1879—Prof. J. D. Parker.
Fragments of Pottery from the Upper Solomon—Prof. D. C. Tillotson.
Artificial Propagation of Food Fishes—Hon. D. B. Long.
Notes on the Botany of Central Kansas—B. B. Smyth.
Douglas County Additions to the List of Kansas Coleoptera—Prof. F. H. Snow.
Preliminary List of the Reptiles of Kansas—Frank W. Cragin.
Traces of the Aborigines in Riley County—Prof. G. H. Failyer.
The Burlington Gravel Beds—Robert Gillham.
Additions to the List of Kansas Lepidoptera—Prof. F. H. Snow.
Memorial of Prof. B. F. Mudge—Prof. J. D. Parker.
Concretionary Forms—Joseph Savage.
Weather Observations in Kansas—Prof. J. T. Lovewell.
The Feldspar Group of Minerals—E. H. Chandler.
The Last New Kansas Bird—Prof. F. H. Snow.
The Igneous Rocks of Kansas—Prof. Robert Hay.
Color-Blindness—Dr. John Fee.
Irrigation—Hon. F. G. Adams.
The Ornithology of Riley County—Dr. C. P. Blachly.
The Rainfall in its Relations to Kansas Farming—H. R. Hilton.
Some New Experiments Lately Exhibited in Boston—Prof. J. T. Lovewell.
Preliminary List of Kansas Hymenoptera—Prof. F. H. Snow.
Stone Implements Found in Trego County—Joseph Savage.
On the Skeleton of an Elephant Found Near Manhattan—Prof. Geo. H. Failyer.
Science Teaching in Common Schools—Hon. F. G. Adams.
A New Form of Pinch-cock—Prof. H. E. Sadler.
Recent Addition to the List of Kansas Plants—Prof. J. H. Carruth.
Mining in New Mexico and Colorado—J. C. Cooper, Esq.
The Coleoptera Collected in Santa Fé Cañon, August, 1880, with Descriptions of New Species by Drs. LeConte and Horn—Prof. F. H. Snow.

Officers for the year 1881 were elected as follows:

President—J. T. Lovewell, of Topeka.

Vice Presidents—Joseph Savage and James H. Carruth, of Lawrence.

Secretary—E. A. Popenoe, of Manhattan.

Treasurer—R. J. Brown, of Leavenworth.

The commissions for the ensuing year were filled as follows:

Geology—O. H. St. John, Joseph Savage, and Robert Gillham.

Mineralogy—J. C. Cooper, E. H. Chandler, G. E. Patrick, G. H. Failyer, and George S. Chase.

Chemistry—J. T. Lovewell, G. H. Failyer, H. E. Sadler, G. E. Patrick, and R. J. Brown.

Physics—J. T. Lovewell, L. A. Thomas, and I. D. Graham.

Meteorology—F. H. Snow, J. T. Lovewell, G. H. Failyer, H. R. Hilton, and J. D. Parker.

Astronomy and Mathematics—H. S. S. Smith, J. T. Lovewell, — Miller, and J. Lee Knight.

Botany—J. H. Carruth, E. N. Plank, and B. B. Smyth.

Zoölogy:

Entomology—E. A. Popenoe, F. H. Snow, and T. B. Ashton.

Ornithology—F. H. Snow, N. S. Goss, and C. P. Blachly.

Ichthyology—D. B. Long and F. H. Snow.

Herpetology—F. W. Cragin, F. H. Snow, and Miss Annie E. Mozley.

Anthropology—F. G. Adams, E. P. West, A. H. Thompson, G. H. Failyer, and J. D. Parker.

Philology—Geo. M. Stearns, D. H. Robinson, and Geo. T. Fairchild.

Board of Curators—J. T. Lovewell, Orestes H. St. John, F. H. Snow, and E. A. Popenoe.

Publication Committee—J. T. Lovewell, J. K. Hudson, and E. A. Popenoe.

RESOLUTIONS.

The committee appointed to prepare suitable resolutions upon the deceased members of the Academy of Science submitted the following:

Whereas, The following members of this Academy have been removed by death since our last annual meeting: Professor Benjamin F. Mudge, of Manhattan, for many years State Geologist, and our honored President at the time of his death; Professor William K. Kedzie, formerly occupying the chair of Chemistry at the State Agricultural College, for several years Chemist to the State Board of Agriculture, and an active member of this Academy, even after his removal to Oberlin College, Ohio; and George P. Cooper, of Topeka, an enthusiastic and promising young entomologist, well known to Eastern specialists as a successful collector of rare Western *coleoptera*—therefore,

Resolved, That, by the death of these members, the Academy has sustained an irreparable loss.

Resolved, That the sympathy of the members of this Academy is hereby extended to the families of the deceased in their great bereavement.

Resolved, That a copy of these resolutions be entered upon the minutes of this Academy.

(Signed) F. H. Snow,
J. D. Parker,
J. H. Carruth.

ADDITIONS TO THE LIBRARY.

There have been received during the time intervening between the report of 1878 and the date of the 1880 meeting, the following:

Psyche—Organ of the Cambridge Entomological Club. Boston. Current numbers to date.

Bulletin of the Torrey Botanical Club. New York. Current numbers to date.

Science Observer. Boston. Numbers to date.

Transactions of the St. Louis Academy of Science. Vol. 4, No. 1.

Transactions of the Connecticut Academy of Arts and Sciences. Vol. 5, part 1.

Proceedings of the Monthly Meetings of the Entomological Section of the Academy of Natural Sciences. Philadelphia.

Proceedings of the Academy of Natural Sciences. Philadelphia. Vol. —, part 2.

Proceedings of the Boston Natural History Society.

Bulletin of the Essex Institute. Salem. Vol. 2, Nos. 10, 11, and 12.

Bulletin de la Société d'Etudes Scientifiques, de Lyon. Vols. 1, 2, 3 and 4—1874–78.

Bulletin de la Société des Science, Lettres et Arts, de Pau. Vol. 8, series 2.

Comptes Rendus, Société Entomologique, de Belgique. Series 2, Nos. 60 to 72, and parts to date for 1880.

Jahresbericht der Naturforschers Vereins Wisconsin, für 1879–80.

And the following separate pamphlets and papers:

Die Ansiedlungen der Normanen in Island, Grönland, und Nord Amerika, im 9,- 10- und 11-jahrhunderts. From the Natural History Society of Wisconsin.

The Heat of the Comstock Lode; and New Methods of Ore Concentration and Gold Amalgamation. By J. A. Church, E. M., Ph. D. From the author.

PAPERS OF 1880.

MEMORIAL OF PROF. BENJAMIN F. MUDGE.

BY JOHN D. PARKER, KANSAS CITY, MO.

Prof. Benjamin Franklin Mudge was born at Orrinton, Maine, Aug. 11, 1817, and died at Manhattan, Kansas, Nov. 21, 1879, in the sixty-second year of his age. When two years old, his father's family moved to Lynn, Mass., which place numbered his ancestors among its first white settlers. His parents were eminent for their piety, charity and hospitality. They encouraged studious habits among their children, providing them with good reading, and stimulating them to literary attainments and knowledge.

Three of Prof. Mudge's older brothers entered the Methodist Episcopal Conference, the oldest of whom died early in his ministry. The second was distinguished as a linguist, particularly in the Greek and Hebrew languages, and the youngest, and only one now living, has an enviable reputation as an author of historical Sunday-school books.

Prof. Mudge graduated at Wesleyan University, Middletown, Connecticut, in 1840, from which institution he received his degree of Master of Arts several years later. During his vacations and at odd moments, he diligently pursued his studies in natural history; and although two years after he graduated he entered the legal profession, yet he never relaxed his interest in science, and for many years the Lynn Natural History rooms contained a large cabinet of his collecting, which was afterward removed to the Kansas Agricultural College, and became the nucleus of the Mudge cabinet.

In childhood he exhibited the same simplicity of life, unselfishness and genuine love of nature, which grew and strengthened with age. Some incidents of his boyhood are illustrative of growing traits of character. When twelve years of age, he was sent with his three older brothers to hoe in a very weedy corn-field. As usual, the outside row, which the plow had scarcely touched, was much the hardest. A momentary query arose among the brothers who should take this row, when Benjamin said, "I will take *that*." This was characteristic of his life. In after years he cheerfully remained at the parental home, discharging home duties, though it imposed upon him several years of service at the shoe business longer than his brothers had performed, in order that they might secure the advantages of the higher

education, although his thirst for study was developed as early in life and as intense as theirs.

An inquisitive mind with regard to natural objects seems to have been born in him. The features of nature in and about Lynn, the home of his youth, are unusually fine and beautiful. The locality is rich in minerals, and the sea-shore is lined with pebbles, polished by the friction of the waves. These were the attractive toys of his childhood, and minerals, incrusted moss and sea-shells became the ornaments of the home of his youth. This collection grew by the accumulation of years into that noble cabinet at Manhattan—a monument worthy of any geologist. To sit on some cliff, and watch a stormy sea as it lashed the rock-bound shore, was the joy of his boyhood recreations. Once, after a great tempest, he stood near the edge of a rocky elevation, below which the mighty waves broke, throwing their spray high in the air. He was so much absorbed in the wild scene that he did not observe the spray sometimes shot somewhat above the rock on which he stood. Suddenly, as if angry at his seeming indifference, the sea sent a column of water into the air far above him, which descending, drenched him and his brother from head to foot. Benjamin enjoyed the mishap very much, and spoke of the sea as a friend who could not do him any real harm.

After practicing law for sixteen years, during which he attained a wide reputation for uprightness and fair dealing, and was honored by the mayoralty of Lynn, closing during his administration many saloons, thus creating quite a reform in the liquor traffic, he removed to Cloverport, Kentucky, where he was connected with the Breckinridge Coal and Oil Company.

On the breaking-out of the Rebellion, he removed to Kansas, a State he had been greatly interested in from its beginnings. He located in Wyandotte county, and his natural love for geology soon becoming known, he frequently delivered lectures on his favorite study through the country. In 1864, although a comparative stranger in the State, through the influence of Hon. I. T. Goodnow, the Superintendent of Public Instruction, he was invited to deliver a course of lectures before the Legislature, whereupon that body conferred upon him the office of State Geologist, an honor entirely unsought, yet thoroughly enjoyed. While the State appropriation provided for the office but a short time, he was subsequently elected State Geologist under the State Board of Agriculture, which office he held during life. During all these years he was constantly receiving specimens from all parts of the State, and many a little fortune has been saved to its owner from hazardous ventures for coal, lead or precious metals, by the truthful and always kindly advice from one who knew well how to read "sermons in stones."

In 1865, he was elected to fill the chair of Natural Sciences in the Kansas Agricultural College, to which institution, with a royal munificence, he donated his entire cabinet. It was during one of his summer excursions that he discovered *Ichthyorins dispar*, a bird with bi-concave vertebræ and teeth —an anomaly to science. In severing his connection with the college, the

students were deeply grieved at his departure, and presented him with a valuable watch, which he always carried—an ever-loving reminder of the mutual affection between students and professor.

The last years of his life he spent chiefly in making collections for Prof. Marsh, of Yale College, and thus brought before the scientific world many new and rare discoveries in palæontology.

On Friday evening, Nov. 21, 1879, Prof. Mudge sat at home with his wife, reading the fifth act of Shakspeare's "King Lear"—the wail over the dead Cordelia—when, feeling a pressure in his head, he stepped out of the door to walk in the cool air. A few moments afterward his wife heard a groan, and hastened to his side, but found him unconscious from a stroke of apoplexy. A physician was hastily summoned, but, by a painless transit, Professor Mudge almost immediately passed to his reward.

On Sunday, November 23d, all Manhattan came to look upon his loved form. Scientific friends from various portions of the State and Missouri came to pay warm tributes of praise to the deceased scientist. To his bearers were added four of his scientific friends, Professors Snow, Popenoe and Parker, and Mr. Joseph Savage, all of whom have been intimately associated with Prof. Mudge in his scientific pursuits. The day was beautiful, and the scene, as the immense procession wound its slow and sad way up Cemetery Hill, will not soon be forgotten. And, as the sprigs of evergreen were thrown lovingly into his open grave, we looked forward to the time when he will possess that blessed immortality of which this is a beautiful emblem.

In the summer vacation of 1867, the writer first became personally acquainted with Prof. Mudge. Called to Lincoln College in April of that year, the writer set himself at work to organize a State Scientific Association. For three months he tried to enlist the people of Topeka in such an organization, without the least success. He then wrote to Prof. Mudge, who thought the time had not yet come in the State for such an enterprise. During the summer vacation, the writer, by special invitation, spent three royal weeks with Prof. Mudge, at his home in Manhattan; and during this visit was matured the plan for organizing the Kansas Natural History Society, which afterward grew into the Kansas Academy of Science. Of this organization Prof. Mudge was elected the first President, and was again President at the time of his death. During these twelve years, he was unwearied in his labors, always cherishing plans for the development of the Academy, whose success formed one of the most joyous experiences of his life. His papers are the results of his own observations and experiments, and are real and substantial contributions to knowledge. While professor at the Kansas Agricultural College, he spent his summer vacations in making collections on the Plains, to enlarge his cabinet—the richest and best in the West; and he would often enrich the private collections of his scientific friends with boxes of specimens. By mutual agreement, Prof. Frank H. Snow, of the State University, and Prof. Mudge had divided scientific work between themselves,

in order to accomplish the largest possible results for the new State—the former giving most of his time to living forms, the latter to fossil forms. While at Topeka, at one time, the attention of Prof. Mudge was elicited by seeing impressions on the flagging stones of the sidewalks, and this led to the valuable discovery in science of the so-called bird tracks of the Osage valley. He did much original work in science, and several species which he discovered bear his name.

But Prof. Mudge did not confine his whole attention to scientific pursuits. He was a keen observer of events, and was essentially a man of the people. There was an earnestness and enthusiasm which glimmered in all he said, like sunshine on a beautiful day. All who knew him were charmed with the truthfulness and simplicity of manner which he possessed. He was the most companionable of men, and people everywhere were attracted to him. He was not afraid of the truth, no matter where it might lead him. No road was so rugged he would not follow it in the pursuit of truth. He would give up the most cherished opinions unhesitatingly, when newly-discovered facts did not sustain them. Still, with all his enthusiasm, he was conservative and prudent, and seldom made mistakes. Those who were intimate with him during our civil war, remember how cheerfully he awaited unfolding events, with a supreme faith in the darkest hours that the right would be triumphant. With him there was no cloud that did not have a silver lining. He manifested the deepest interest in educational progress, and in the growth of the State institutions. He was the life of teachers' associations, and was a favorite lecturer at teachers' institutes. Prof. Mudge was an earnest temperance worker, and a permanent member of many temperance organizations, both in Massachusetts and Kansas. While living at Quindaro, during the war, one of the border towns of Kansas, there was great excitement on the slavery question. Some runaway slaves from Missouri came to Prof. Mudge for work and protection. Their masters offered a large reward for their recovery, and his home and life were threatened in a midnight attack. He would not yield to threats, however, but protected the refugees, and saved them from being dragged back into slavery.

Prof. Mudge possessed fortitude, or passive courage, which is characteristic of great minds. While living in the West, his sensitive nature suffered many things incident to a formative condition of affairs. But as a pioneer in laying the foundations of society, he moved calmly forward in the discharge of duty, regardless of personal consequences. He possessed great benevolence of being, and always took the most charitable view of human actions. He worked harmoniously with his associates, and as far as possible lived peaceably with all men.

As a teacher, Prof. Mudge was loved and revered by all his pupils. His pleasant and genial manner encouraged the timid, his unfailing knowledge and warm memory served to quicken the ambitious, and his tact and practical insight into personal things developed many a dull scholar to a promi-

nent place in his class. His studies were attractive, and his methods of teaching were characterized by originality. As a teacher, Prof. Mudge was not *bookish*, although he always prized books for what they are worth. He was truly an original investigator, and nature was the great volume ever placed before him. His love of nature was unbounded, and he seemed to live in the field. His thoughts naturally ran back to his experiences in the field rather than to books, and he drew very largely for his scientific knowledge from original observations. He was the hero of all scientific parties going out from the Agricultural College, and none were considered complete without him as a leader.

In 1871, in speaking of fossil flora, Prof. Mudge mentioned eighteen new species which he had discovered. At another time, a few years later, he spoke of thirty-six new species. On the day of his death he spoke of eighty which he had discovered, and there are probably many more, for he was always very modest in speaking of his own work, while he was ever glad to notice that of others.

Prof. Mudge was the prince of collectors in the West, and possessed all those qualities of body and mind that made him truly successful. As a platform lecturer on scientific subjects, he was a general favorite with all classes. In a graceful and easy manner his ample stores of scientific knowledge would flow forth in rich, spontaneous utterances, and he was able to throw a peculiar charm around the facts of science. The University of Kansas lately honored herself by placing him upon her corps of special lecturers. He was wholly absorbed in his college duties, and was the student's best friend. He opened doors in the temple of science, and inspired his pupils to enter and explore for themselves. As a friend and companion, he was always true and genial. His friendships were remarkably warm and lasting. He was greatly beloved by all his neighbors, and this is a sure test of a good man. He possessed a native purity and refinement of soul, more akin to the refined nature of woman, which never forsook him in his most social hours. He seemed to be born without fear, and his scientific friends relate instances in their western explorations when he would lie down without fear, and sleep till morning, surrounded by hostile Indians. He possessed great simplicity of life, and always felt as if he was a young man. He was always giving public lectures without compensation, and studying methods of conferring favors upon his friends. He feared God and loved righteousness, and those who knew him best believe that he possessed a deep religious nature.

As long as science has a name and place in the great central plains of the North American continent, Prof. Mudge will not be forgotten as a scientific explorer and discoverer.

METAMORPHIC DEPOSIT IN WOODSON COUNTY.

BY PROF. B. F. MUDGE, A. M.

Much excitement has existed for a year past in Woodson county, Kansas, in relation to the alleged mines of gold and silver at Belmont. These reports induced me, in June, 1879, to visit the spot, in company with Prof. Hay. We found evidence of metamorphic action which I had never before seen in Kansas, except at the lead mines in the subcarboniferous deposits in the southeastern part of Cherokee county. The area under consideration is in the coal measures, and is nearly one mile long and one-third as wide. This lies in sections 29 and 32, town 26, range 15, east. Outside of this small area, the lime shales and sandstones in all directions remain unaltered. Some twenty shafts have been opened in the vain attempt to find valuable ores. These enabled us obtain a most accurate knowledge of the metamorphic action. I saw no rock which indicated that the changes observed were caused by the direct action of fire. The moderate metamorphism was, in my estimation, clearly caused by the action of warm mineral salicious waters, and probable under-pressure. The change was most marked on the porous sandstones, and less so on the limestones and clay shales. The vapors and hot waters had expelled a portion of the calcareous material of the limestone, and hardened it, by replacing the lost matter with silica. This destroyed the fossils only in part, but gave it a black, basaltic appearance. The clay shales had assumed a more granular appearance, interspersed with small flakes of mica. We saw over thirty feet of this stratum in several places.

But the most marked metamorphic action was seen in the common sandstone. Its porous character allowed the hot steam and vapor to penetrate freely into all portions of the stratum. At the western portion, near the center of the northwest quarter of section 32, this is seen in blocks of quartzite, about a foot in diameter, and three or four feet long. These lie on the surface, evidently left by the denudation of a portion of the stratum. About half a mile farther east, where several good-sized shafts are opened, the changes by metamorphic action could be studied in all their details. On the surface were masses of quartz containing clear, glassy crystals, and at one spot quite a number of specimens of beautiful amethyst. This is the first locality of the latter mineral I have found in Kansas.

Here, in a large shaft, about thirty feet deep and nearly as long, can be seen the most varied changes. After penetrating five feet of loose surface material, we have at one edge of the shaft eighteen inches of unaltered red sandstone; below which it is soon altered to a dark-blue chert, and again to pale blue, then cloudy, and finally to a nearly pure white, fine-grained, hard quartzite. In the latter were small spots of carbonate of lime, which could be scratched by the finger-nail. In one side of the shaft, the sandstone as-

sumed the form of bluish-green chert, with small, white spots. This was seen in many of the openings or shafts, and was the rock said to contain the most silver. At a few places the stratum was twisted into small folds, as if the hot water had rendered it plastic, and the pressure had caused it to yield. The colors usually shaded into each other, but sometimes the change was abrupt.

At the deepest shaft, Mr. Van Meter's, the bluish-green chert, or quartzite, is traversed by veins of white quartz, which was said to contain gold; but a portion which I took out did not yield a trace of that metal.

Near the center of the metamorphic area, the strata were dipped as much as 45°. This was undoubtedly caused by the washing-out of the underlying stratum, and was very local. At several places we saw sharp, angular fragments of chert, which had become cemented together by the same material. This feature is frequently seen at the lead mines of Cherokee county. In nearly all other respects, the metamorphic action at the two localities are entirely different.

I have caused some of the rock said to yield silver—some specimens given me at the mines, and some that I broke from the ledges and shafts—to be analyzed by Professors Patrick, of the State University, and Failyer, of the State Agricultural College, and no trace of silver, or any metal except iron, was found. I was surprised, when I saw the metamorphic action, not to find any lead, which is usually met with under such circumstances.

I was told at Belmont that assays of rock from these shafts had been made by chemists in Massachusetts and Colorado, and silver had been obtained, varying in amount from $5 per ton to $6.25 per ton. This, it will be seen, is fully equal to the silver mines at Leadville; but, on the other hand, though several thousand dollars have been spent, not a single ounce has been sold as the product of all the mines. This should settle the practical question of the advisability of the enterprise. Whether the ore was "salted" before it started for Massachusetts, or whether the whole story was a fabrication, I do not know.

I have been thus particular in the description of these mines, because I am constantly consulted on similar wild metallic stories about rich deposits in Kansas, and because the metamorphic action indicated a possibility that silver might be found.

A HOLIDAY EXCURSION TO THE BIRTHPLACE OF MONTEZUMA.

THEO. S. CASE, KANSAS CITY, MO.

Before entering upon a description of the ruins of the Pécos pueblo and church, I will say, that notwithstanding the volumes that have been written by the explorers of this central portion of the western hemisphere, descriptive of its past civilization, the vastness and perfection of that civilization

have been by no means comprehended. Every day the hardy and venturesome prospectors of New Mexico, who, like the Spaniards of the sixteenth century, are urged on by an ardent quest of precious metals, discover new evidences of the existence, in prehistoric times, of a race of men, who in architecture, agriculture and the working of gold and silver, possessed a degree of knowledge and skill hardly surpassed in any age. The discoveries of these explorers also go far to prove that the land which is now so unproductive was once sufficiently arable and prolific of vegetation to sustain a dense population, and that the various reasons which are proposed by the writers of the present day to account for the abandonment of the country by these people, such as superstitious fear, the persecutions of hostile tribes, etc., are futile and unacceptable. It seems unquestionable that some vast change took place in the geological and physical condition of the country, causing its fountains to dry up, and changing its fertile valleys into arid wastes, thus literally starving the people out, and forcing them to seek new homes. This idea brings to the front the theory of the continent of Atlantis, with more plausibility than almost any other—a theory which, if established, will enable us to account for the migration of ancient peoples from one continent to the other, without taxing our credulity with the extremely doubtful one of the Behring's straits route. But since this route is buried in the mists of ages, possibly as far back as the Miocene period, when man did not exist, so far as we have been able to discover, we need not discuss it; especially when some of the most learned ethnologists, such as Prof. Retzius and Dr. Daniel Wilson, assert and apparently prove that the brachycephalic race can be traced through the Kurile islands and on the continent, from the latitude of Behring's straits, through Oregon, Mexico and Central America, and the whole length of South America, to Patagonia; also, that the mound-builders of the North were certainly of the same cranial type with the ancient Mexicans and Peruvians. The Abbe Brasseur de Bourbourg, after the ablest and most extensive researches, declares that the pre-Aztec Mexicans or Toltecs were a people identical with the mound-builders; and Col. J. W. Foster, in his admirable work, the "Prehistoric Races of the United States," says that "They possessed a conformation of skull which would link them to the autocthones of this hemisphere—a conformation which was subsequently represented in the people who developed the ancient civilization of Mexico and Central America."

Winchell, in his Preadamites, includes the Pueblo Indians of North America, under the type of Asiatic Americans, and says: "These tribes bear so distinctly an Asiatic stamp as to point to the Mongoloid regions of the Old World as the home of their remote ancestors."

On the other hand, there are not wanting authorities who believe and assert that the civilization of New Mexico is a degraded successor of that of Central America and old Mexico, and that the migration furnishing the tribes that constructed the edifices of New Mexico, was from the South north-

ward, instead of from the North southwardly, in accordance with the traditions of the Aztecs. Among these authorities are Bartlett and Squier, the latter of whom declares that the hypothesis of a migration from Nicaragua and Cuscatlan to Anahuac or Mexico is altogether more consonant with probabilities. Leaving the ethnologists to unravel this mass of contending facts and themes, we will proceed with our narrative.

Arrived at Baughl's station, on the Atchison, Topeka & Santa Fé Railroad, which is no more than a siding, where railroad ties are received and handled, and which simply consists of a boarding car and two saloons, we started on foot for the scene of our explorations, about one mile and a half distant.

Before we had proceeded more than half a mile, we came into view of the church and ruins of Pécos, lying on a beautiful plateau on the further side of the Pécos river, and separated by a narrow valley from a commanding range of mountains several miles beyond. This plateau seemed to be completely surrounded by mountains; those on the west being grand in their outline, and crowned by a bald peak, which appeared exactly adapted for a watch-tower for the people of the city on the plateau, and perhaps for an outlook for the priests of the sun, who, from its lofty summit, could catch his earliest rays long before they would be visible to the people below. The whole valley, from mountain range to mountain range, is about five or six miles, while it seems to be inclosed at both ends by purple ranges, about ten miles apart, with an occasional snow-capped peak. Thus apparently hemmed in on all sides, and in the midst of what was probably in the day of their prosperity a luxuriant and fertile plain, these ancient people built their singular houses, and lived peaceful and quiet lives. The evidences of their civilization are found in abundance, in implements for grinding corn, pottery evincing various degrees of skill, and in some places in pictured rocks and decorated caves.

These houses are very much alike in all the villages that are known, being built against the sides of bluffs or rocky acclivities, one story above another, to the height sometimes of five to six or seven stories. The material used is stone, cemented together, and sometimes coated or plastered on the outside with mud. The first story has no opening except at the top, which is reached with a ladder, while the other stories have doors opening from the roofs of those below. Within, or at least in the lower or basement stories, there are connecting openings from one to another. The stories are separated by floors of timbers laid together, and sometimes bound together with withes. Remains of corner-posts, made of pine and cedar poles, are found abundantly in their proper positions.

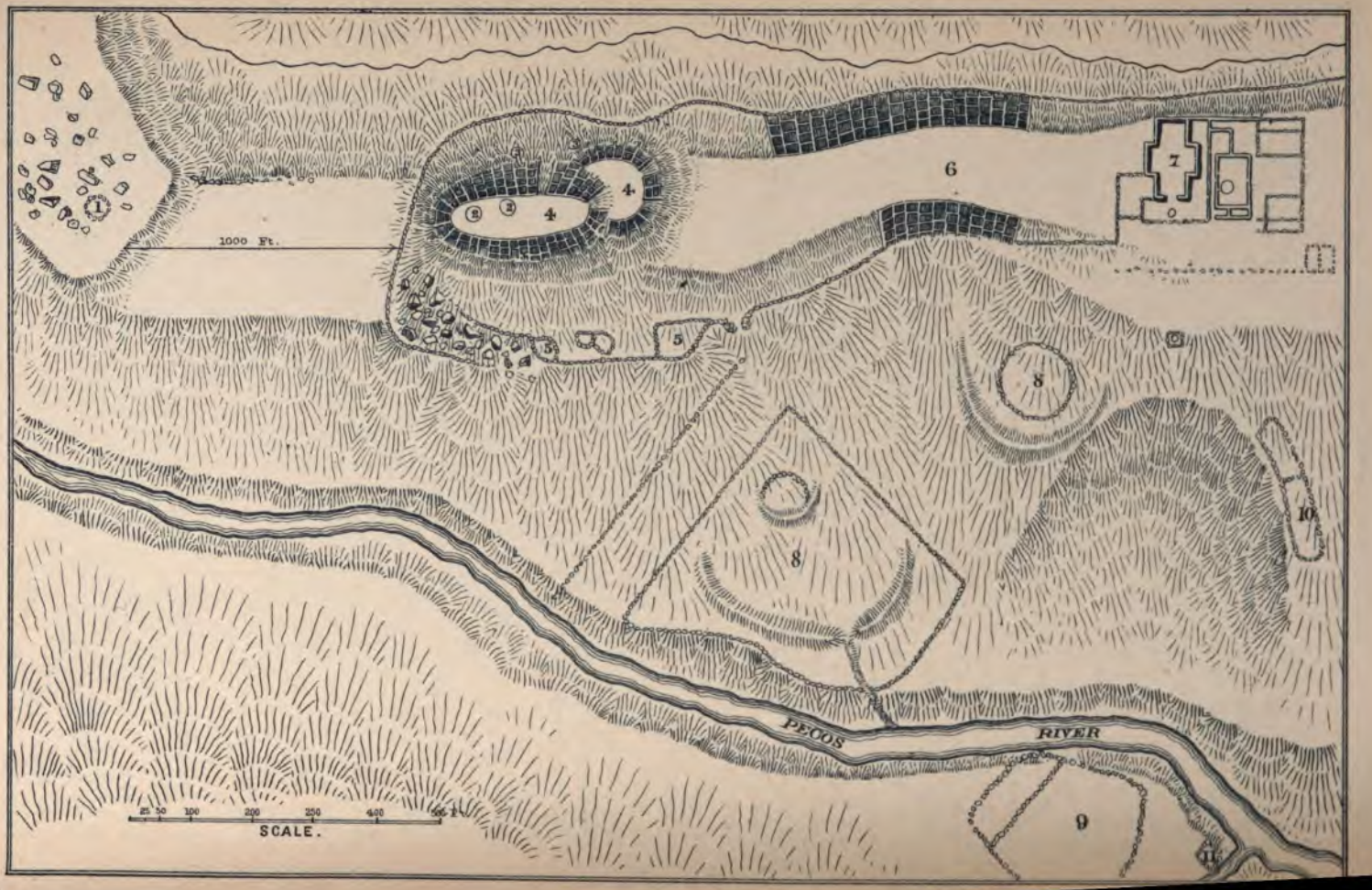
The system of walls and outworks is very extensive, but whether it is all of the same age as the village, is more than I was able to determine. Commencing at the western end of the plateau, the first evidence of the hand of man that I discovered was a circular stone wall inclosing a space thirty feet in diameter. (1 in plate.) This is located upon a rocky point some 50 feet above

the adjacent ground, and commands a view of the valleys on both sides, as well as of the plateau beyond, upon which the village is built. From all indications, this was a fort or lookout tower. (W. H. Holmes, in Bulletin No. 1 of the United States Geological and Geographical Survey of the Territories, vol. II, 1876, describes the ruins of a tower found in the Mancos cañon in Colorado, probably similar to this, whose outer dimensions were forty-five feet in diameter, and twelve feet in height at the highest point of the wall yet standing, which is twenty-one inches in thickness. It was double-walled, with apartments between the outer and inner walls. On the *mesa* above the bed of the river McElmo, a square-shaped tower was discovered standing in on the summit of a great block of sandstone, forty feet high, and detached from the bluff back of it. At another place on the McElmo, the ruins of a triple-walled tower were found, with sectional apartments between the outer and second walls; and such towers abound on prominent points all along the Gila, Chaco, Rio Grande, and other rivers of Colorado and New Mexico.) Proceeding eastwardly, we descend from this point some twenty feet or more to a long and narrow passage of bare rock, not less than 1,000 feet long, by an average width of about 100 feet. On the north side, this passage is defended by a stone wall running along the edge of the rock for a distance of about 300 feet. For the remainder of the distance to the foot of the bluff upon which the ruined village is built, there is no sign of any work done by man.

At the foot of the bluff just mentioned, we come upon the remains of a stone wall, which runs around both sides of the plateau from village to church, being in its whole length not less than 2,000 feet. This wall seems to have been intended for defense, as it is located on the extreme edge of the plateau, all around, just where the steep and almost perpendicular declivity begins.

Commencing here, we are amazed at the size of these ruins. (4.) The buildings were commenced at the foot of the bluff, the rooms of the first story being, say, eight by ten feet, and about seven feet in height. The rooms on this floor have no doors in the side walls, but are entered from the roof, which is reached by a ladder. Upon this story another is built, which is set back from the front of the first, and like it, leans against the side of the bluff. This story has doors in the front of the rooms, which are entered from the roof of the lower story. In this way as many as six or seven stories are built, one upon another, and the buildings are extended laterally as far as the necessities of the community demand, all united as closely together as cells in a honey-comb.

In this Pécos village there were not less than 1,000 rooms, and probably many more. I could readily count 200 rooms at the top, and from four to six stories on the sides of the bluff. The whole group seemed to consist of two irregular circles, the larger of which extended partially around the end of a rocky bluff, about thirty feet high above the bare rock just described,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rising two stories above its summit, and completing the circle or oval upon the surface of the bluff. This circle is 225 feet across in one direction, say east and west, and seventy in the other, with one opening or passage, say sixteen feet wide, leading down the face of the bluff on the northern side, and one into the inclosure on the east.

This area contains two basin-shaped, stone-lined reservoirs, probably for water, twenty-five feet in diameter and more than six feet deep (2), as was proven by digging into them to that depth without finding the bottom of the stone lining. They are filled with earth to within some three or four feet of the surface. Outside of the circle of huts, at the foot of the bluff on the north side, but inside of the stone wall above named, are two similar stone-lined, basin-shaped reservoirs, sixteen feet in diameter, and filled within two or three feet of the surface. (3.) One of these is on each side of the passage-way before mentioned. A very singular thing is, that the western of these reservoirs seems to be connected with one of those inside by an aqueduct or conductor, constructed wholly of cement* made of ashes and some other substance, possibly lime, though no lime or cement of any kind is found in any other part of the works.

This aqueduct is exposed at the margin of the reservoir nearest the bluff, and is at least two feet in diameter, with walls not less than eighteen or twenty inches in thickness. It was constructed by making lumps and blocks of the cement, some rounded and some flat, varying from four to ten inches in diameter, and laying them upon each other like bricks, and fastening them together with layers of similar cement, and finally smoothing the whole over with a coating of the same. I had no implement but an old hatchet, and could do but little in the way of excavating this aqueduct, and may have been mistaken as to its object and purpose; but from its locality and shape, as disclosed by my cutting into it some two feet or more, I think I am correct.

Adjoining the inclosure above described on the east, is a small one, also built around with similar stone huts, two stories high, which is about sixty by seventy feet in diameter, and has two gateways, one to the northeast and the other to the southeast, each ten feet wide and thirty-six feet long. To the southward of both of these inclosures, and close to the rocky declivity, which is bold and commanding, are several remains of walls and buildings, nothing being left but the foundations and some loose rock. The first or western of these is 24x58 feet, the second 24x27, and the third 10x30. Still further east, and on the extreme point of the rock, is a triangular-shaped inclosure 54x69, the third side being made by the wall on the edge of the bluff. From the situation of these (5), especially the last named, they were evidently for the purposes of outlook and defense.

Just east of the huts last described, the ground slopes rapidly to the east

*The Mineralogist of the Smithsonian Institution reports that this cement "is composed of silica, carbonate of lime, and carbonate of magnesia, with a trace of iron."

and south, with ledges of bare rock making a kind of wall to the southward and westward. Still proceeding eastwardly, we pass over some two hundred feet of bare, smooth rock, when we come to two other groups of ruins (6), about four hundred feet in length, one on each side and overhanging the respective bluffs on the north and south sides of the plateau. There are about eighty huts in each of these groups on the summit, making probably about two hundred in all, when averaged at two stories high. They are similar to those just described, being made of stone cemented together with mud, and arranged in rooms of from six to ten feet square, those in the basement story being connected by openings underground. Between these groups of huts the space is nearly or quite two hundred feet wide.

We did not find any rooms among them answering to the description given by several explorers of the *estufas*, where the sacred fire was kept burning, unless the circular, stone-lined basins, within the court of the larger village, may have been originally covered over and used for such a purpose. (Dr. Hammond, who accompanied Lieutenant Simpson in his United States military reconnoissance in New Mexico, in describing the ruins of Chaco, speaks of sacred *estufas*, circular in form, excavated several feet deep in the earth, and inclosed with circular walls.) The fact that no water, except perhaps the drippings from the roofs of the upper tier of huts, could naturally find its way into these basins, gives probability to the suggestion that they may have been constructed for *estufas*, instead of for storing water.

On the south side of the plateau, about half-way between the first and second village, is a gateway in the outer wall, which in that part is six or seven feet high and from three to four feet thick. This gateway is about ten feet wide, and was apparently made to enable the inhabitants to pass out their stock to graze and to water in the inclosures which will be described a little later.

Having now described nearly everything on the plateau that seems to belong to the Aztec civilization, we will pass out of the gate just mentioned, on to the slope that descends gradually to the Pécos river, which winds its way along at a distance of a few hundred yards to the southwardly.

The first thing which attracts our attention is a long stretch of ruined wall, which extends in a southwestwardly direction from a point within about 120 feet from the gate to the bank of the river, 600 feet away. Just beyond the upper end of this wall we find an inclosure (8), walled all the way around, 390 feet by about 120 feet, and banked up with earth at the lower part, as if to retain water. Just at the lower corner there appears to have been an artificial outlet through the dam and wall, for prudential purposes. Within this inclosure is a circular artificial pond, also banked up with earth, about seventy-five feet in diameter. Just east of this inclosure and a little further up the slope is another (8), apparently constructed for the same purpose, being nearly as large, and banked up across the lower part in a similar manner. Within this, also, is a smaller circular pond, 120 feet across, which even at this time was muddy in the center, although it did not contain any water.

Still proceeding eastwardly, there are traces of walls and apparent foundations of buildings all along the slope, and on a little eminence about 200 yards southeastwardly of the inclosure last described, are the remains of two walls (10), inclosing spaces respectively 100 feet square and 125x140.

On the opposite side of the Pécos river, between it and a small stream which empties into it, and 345 feet southeast of the water inclosure first above described, is a kind of pentagonal inclosure, 240 feet in diameter (9), and crossed by another wall which divides it into one large and one very narrow compartment. Just beyond and southeast of this are the remains of what has apparently been a fortification situated just at the confluence of the two streams.

This completes the description of the outside works. We will now return to the plateau. Passing from the groups of Aztec huts last described, we proceed eastwardly 180 feet, and find ourselves face to face with the old Pécos church itself. Before describing this old building (7), we will refer to the history of the discovery of the village, which had its origin long before the Spanish invasion, and which is held by the Aztecs to have been the birthplace of Montezuma himself.

There seems to be no doubt that the Aztecs migrated from some more northern region into Mexico, and the traditions of the present Pueblos, who are believed to be descendants of the original Aztecs, teach that this very spot was the birthplace of Montezuma. But Short, in his "North Americans of Antiquity," claims that this is a different civilization, and that the culture god Montezuma of the Pueblos and the Aztec monarch, Montezuma, are not to be confounded. Dr. Foster, in his "Prehistoric Races of America," does not speak of any such distinction. At all events, all writers agree that Pécos is one of the most important of all the ancient ruins of this region, and that it was one of the sacred cities of the Pueblos. Here the everlasting fire, dedicated to their god Montezuma, was kept burning from time immemorial down to the abandonment of the town, which occurred, according to Short, some time during the socond quarter of the present century. Other authorities fix the year at 1837.

One tradition is that Montezuma was born at Acoma, and subsequently removed to Pécos, where he taught the people the arts of civilization, and that when he removed to the south he told them to keep the sacred fire burning until his return. But he never came. Warriors watched the fires, and remained on duty by turns, until, through decimation, from one cause and another, the tribe became too much reduced in numbers to keep up the watch any longer. Then three warriors took the remains of the fire and carried it into the mountains, where Montezuma himself appeared and received it. Thus relieved, they abandoned their village, and joined their brothers west of the Rio Grande.

"For generations," as Short eloquently says, "these strange architects and faithful priests waited for the return of their god—looked for him to come

with the sun, and descend by the column of smoke which rose from the sacred fire. As of old the Israelitish watcher upon Mt. Seir replied to the inquiry, 'What of the night?' 'The morning cometh,' so the Pueblo sentinel mounts the house-top at Pécos, and gazes wistfully into the east for the golden appearance—for the rapturous vision of his redeemer, for Montezuma's return—and though no ray of light meets his watching eye, his never-failing faith, with cruel deception, replies, 'The morning cometh.'"

In about 1540, Coronado, the Spanish Governor of New Spain, lured by the resistless rumor of boundless wealth of gold and silver, which no Spaniard could withstand, led an expedition to this very village, then called Cicuyé. The Pécos river must have been a far larger stream than at present, as Coronado found it frozen over with ice strong enough to bear up his horses. He found the settlement of Cicuyé extending along the river for six miles, and the soil extensively cultivated by the Indians. It was from that time that the decline of the tribe commenced. The date of the building of the church is not exactly known,* but it was probably very soon after the invasion by Coronado, for zeal in religious matters was next to lust for gold in the heart of the Castilian, in all of his conquests.

We may imagine that the gentle and tractable Pueblos were speedily induced by their enthusiastic conquerors to embrace Christianity, and that the building of this church was a work of fear of temporal power, rather than of faith in and love of the deity represented by the Spaniards. It was constructed of adobes, which are about sixteen inches long, twelve inches wide, and three inches thick. Its shape is that of the Latin cross, its walls six feet thick, and its dimensions one hundred and forty feet long by forty feet wide, the transverse portion being fifty-seven by thirty-five feet, and its original height about thirty feet. There were several smaller rooms attached on each side, and possibly a building of considerable dimensions on the west side, as there are traces of adobe walls which indicate either a building or an inclosure divided into smaller rooms or lots. I have in my possession a book published in 1854, containing an engraving which represents the church as having a building on the west side. I could find nothing in the appearance of the ground to indicate anything of the kind, either in the way of rubbish or otherwise, and it seems to me, if the church itself could so well withstand the ravages of time, any adjoining building would have endured as well. The roof of the church has been nearly gone for many years, and the side-walls of the front end are also crumbled away nearly to the ground. The rear portion is nearly at its original height, and some of the cross-beams, with their rude carvings, remain *in situ*. The others have been cut away by curiosity-hunters.

The adobes of which the building is constructed are made of a reddish clay, containing small pieces of pottery of a ruder and coarser order than that

*Mr. A. Goselachowski informs me that it was probably erected just about 250 years ago, by the Spanish Jesuits, and that the town and church were destroyed by the Comanche Indians in the latter part of the eighteenth century.

found about the Pueblo villages. In one of these inclosures, just west of the church, is a small excavation, about twelve feet in diameter, evidently the remains of a water reservoir. Immediately in front of the entrance, and about forty feet from it, is what seems to be an old well, which has been walled up with stone, and has been more recently filled up with earth.

About seventy-five feet still further on, we come to the traces of an old wall terminating on the east in the ruins of several small rooms or inclosures, also of stone. About eighty feet still further, and directly in front of the entrance to the church, is an inclosure about eighteen feet square, with a central stone-heap about three feet square. Still further in the same direction, we find a semi-circular declivity, which was probably originally the work of man, which terminates on the right at the water inclosure described on page 18. In speaking of walls, it is to be remembered that most of them are ruins, and many of them mere traces, although readily discernible as one walks over the ground. (7.)

Leaving the church for the present, we will turn back to the ruined villages in search of relics. Broken pottery abounds on all hands, and it seemed to me that I could detect specimens representing at least three distinct periods of time: First, and oldest, that found in the adobes, of which the church is built, which is coarse and rough; second, that which is made of finer clay, but without ornament; and lastly, that which is painted; and perhaps fourthly, that which shows an effort at glazing.

We found numerous flint arrow-heads, all of which were small, none being over one and a half inches in length. Perhaps this is due to the fact that the larger ones have been picked up by earlier explorers. We also found several broken *metatas*, or grinding pestles; and in one of the large rocks near the upper village, I found three bowl-shaped cavities, about ten inches in diameter, and from three to four inches deep, which I conceived to be the mortars in which the natives ground or beat their corn into meal.

We also found numerous pieces of obsidian, which appeared to have been split off in keen flakes for cutting purposes; also fragments of smoking pipes, with more or less ornamentation cut or scratched upon them. Besides these things, we discovered smaller ornaments, in the way of shells pierced for suspension, pieces of selenite roughly carved into ornamental shapes, and small bits of red paint. Not a scrap of iron, or any kind of metallic weapon, tool or implement could be discovered in either church or village — not even a nail — though it is well known that the natives understood the art of smelting ores — at least those of silver and gold, and of working them most artistically. If other proof of this knowledge were wanting, we could supply it in the form of several pieces of slag picked up near the villages; and the people who reside near say that remains of old smelting works are still to be found in the mountains.

Parts of three days were given to this exploration, in company with Mrs. Case, Major H. Inman, of Kansas, and Mr. A. H. Whitmore, of Las Vegas,

all of us being greatly interested, and more than willing to devote much longer time and labor to a more complete examination of these ruins, should another opportunity present itself when we were better prepared to do them justice.

A great many more most interesting things were seen by us in New Mexico, but the limits of this paper have been reached, and an account of the remainder must be postponed until another time, with the closing suggestion, that had these industrious and ingenious natives not been disturbed and driven out by the thriftless and avaricious Spaniards, who never improved any country by their conquest of it, they would in all probability have built up the ruling empire of North America, and thus at least have kept alive the fire of civilization kindled by Montezuma—the culture god—in their minds, until the day of his return, in the millennium.

THE GREAT SPIRIT SPRING.

BY PROF. G. E. PATRICK, STATE UNIVERSITY, LAWRENCE.

The "Great Spirit" or "Waconda" spring, situated near Cawker City, Mitchell county, Kansas, is a natural curiosity that has excited much interest among both the savage and civilized inhabitants of the State. From time immemorial, this spring has been held in devout reverence by the Indian tribes that but a few years since hunted over middle and western Kansas; and since the advent of the white man, it has become widely known as an object of wonder and speculation among lovers and students of nature.

The spring is distant from Cawker City about two and one-half miles, in a southeasterly direction; is just within the lower bottom of the Solomon river, being perhaps 300 feet from the first terrace, and about sixty rods from the present bed of the river. It flows, not after the manner of most springs, from some hidden nook or cavern, but from the summit of a nearly symmetrical mound, shaped like a low-statured sugar loaf—or, to be more mathematical, like a truncated cone. This mound is forty-two feet high, nearly as level on the top as a floor; and in the center of this small table-land is found the spring itself, which is quite as remarkable as are its surroundings. Instead of a gurgling rivulet, trickling away among the rocks, the visitor sees before him a smooth, almost motionless body of water, more than fifty feet across, and filling its basin to overflowing—or if not to actual overflowing, so near it that its surface appears to be upon a level with the top of the mound, and in imminent danger of flowing over at any and all points. The only reason why such overflow does not occur is, that the rock forming the mound is very porous, and affords innumerable minute outlets, just equaling in combined capacity the subterranean inlet.

The dimensions of the mound and basin are as follows, from actual measurement: height of mound, 42 feet; diameter at base, 300 feet; diameter at top, 150 feet. The basin, shaped like a funnel—or better, like an inverted cone—is 35 feet deep at the center; its diameter at top, from "water's edge to water's edge," is, N. to S., 52 feet 4 inches; E. to W., 56 feet 8 inches. These figures show the surface of the pool to be very nearly circular. The limestone stratum inclosing it like a ring, of almost uniform width, makes a fine drive-way for carriages, which find an easy ascent at one especially favorable point.

The reverence with which the Indians have always regarded the "Waconda" spring, is worthy of notice, as exhibiting in a marked degree some mental traits of a race destined soon to pass away. Upon this subject my knowledge is all at second hand, but I am fortunate in having the following statement from one of the earliest settlers of Mitchell county, now a resident of Cawker City, a man whose character vouches for the truth of his words. In response to a request from me, he writes: "In answer will say, that through Indian interpreters I have the statement from various tribes visiting our spring, that Waconda, the daughter of a great Indian chief, at one time became infatuated with the son of another. The two tribes met at the spring, and being hostile to each other, the intimacy was strongly opposed by the parents, and a conflict ensued. The lover of Waconda, being wounded and weak from loss of blood, fell or was hurled into the pool, whereupon Waconda plunged in after him, and both were drowned. Ever since the spring has been called 'Waconda,' or the 'Great Spirit' spring, and the Indians believe that the spirit of Waconda still dwells in the mound, and sometimes becomes offended at bad Indians, and throws up vast volumes of water, drowning them. The Pottawatomies, who have often been through here on their hunts since this country was settled, could never be prevailed upon to pass the spring without stopping to have a regular pow-wow, and dip their arrows into its waters. They believed this would give them great success in their hunts and wars with other tribes. Every tribe that has ever visited this country since its earliest settlement, has shown the greatest reverence for the spring, never failing to visit it, and always going through a ceremony over its waters. On one occasion we invited 300 Indians, who were on a buffalo hunt, and were encamped near the spring, to come up to Cawker City and give us a war dance. They accepted, but on no condition would they come until they had been to the spring and daubed their faces and ponies with the gray mud from its banks, and when they came, their appearance in the light of the bonfires built for the occasion was frightful in the extreme."

From the same gentleman, as well as from others, I learn that many relics have been "fished" from the pool, including bows and arrows, a bent rifle or two, arrow-heads, colored stones, medals and beads, (one medal bearing the stamp, "The Fur Company of 1844," and the figures of a white man and an

Indian making friends over a pipe of peace,) articles thrown in probably to propitiate the Great Spirit.

It is asserted by many who have made frequent use of the waters of this spring, that they possess valuable medicinal qualities; and as they have acquired more than a local reputation, I have deemed it worth the while to visit the spring, collect samples of the water, and submit the same to thorough chemical analysis. The following are the results, each figure being the mean of at least two closely-accordant determinations:

Specific gravity at 60° Fah., 1.017.	*Grains to U. S. gallon.*
Sodium chloride	775.703
Sodium bromide	.234
Sodium sulphate*	206.357
Magnesium sulphate	66.050
Magnesium carbonate	41.023
Calcium carbonate	31.398
Silica (probably combined with soda)	Traces.
Nitrous acid	Minute trace.
Organic matter	None.
Total solids, upon evaporation	1120.765

Carbonic acid gas evolved upon boiling, 91 cubic inches to the gallon U. S.

From this analysis it is seen that the water of this spring bears a general resemblance to several other waters of the State that have been analyzed, among them that of the Iola gas well, my report upon which was published in the proceedings of this Academy for 1876—the general resemblance consisting in the presence of a large amount of sodium chloride, considerable quantities of the salts of magnesium or calcium, or both, (besides the carbonates of those metals,) and, usually, some sodium sulphate.

While there is this resemblance, the water of the Great Spirit spring differs from all those hitherto examined, in the great amount of sodium sulphate which it contains. In it the sulphates (of sodium and magnesium) constitute over 24 per cent. of the total solids, while in the Iola water they are but a mere trace—little more than .1 per cent. Curiously enough, the two waters (Great Spirit and Iola) contain the same very small amount of bromide (probably of sodium), namely, .234 grain to the gallon. But in respect to iron they differ again, the Iola giving 1.343 grains of ferrous carbonate to the gallon, the Great Spirit containing not a trace.

The most peculiar feature about the spring is the mound, from the top of which it issues. All the reports I have seen—and several have been published in various newspapers—assert that the mound has been built up by the gradual deposition of the saline ingredients of the water; and I visited the spot fully expecting to find a mound composed of sulphates and carbonates of calcium and magnesium, arranged in concentric layers conforming to the outline of the mound, as would be the case had the water of the spring been

*In a private report, made some time since, a small amount of the sodium was stated as bicarbonate, and an equivalent amount of magnesium as sulphate. This is probably the more accurate form of statement, as indicated by the CO_2 determination and by the alkalinity after *long* boiling; but the ... accordance with the mode of statement now adopted by many chemists, and is in some ... aferable.

the architect. But instead of any such arrangement I found the mound to be composed of horizontal strata of limestone, broken off sharply at the edges, where sections of many feet in thickness are exposed. This limestone surprised me by its extreme hardness, which was from four to five, and in some places seemed to me to exceed the latter figure; indeed, so remarkable was it in this respect, that I could hardly believe it to be a mere limestone until I had applied a chemical test. Although it is a limestone, it is not an ordinary one, as is evident from its physical appearance. It is exceedingly porous and unhomogeneous, showing everywhere the results of chemical change effected by some ingredient of the spring-water. That this change has consisted largely in the formation of a hard, insoluble silicate, by metathetical reaction between the sodium silicate of the water and the carbonate of the limestone (or possibly of the water itself), is evident from the physical appearance of the rock. The portions showing the greatest porosity are the hardest, and in the larger cavities a hard layer of silicate can be distinctly seen and easily identified as such.

Although the silica of the water is in so small quantity as to be reported as "traces," I think it perfectly competent to have effected this change, considering the long time it has had for its work. Moreover, it is the only conceivable agent, under the circumstances.

Being curious to learn what changes, if any, had taken place in the bases of the original limestone, I selected a piece in which silicification had occurred but moderately, and submitted it to analysis, after having removed by washing all the soluble salts deposited in its pores, with the following result:

Lime, Ca O	52.99	per cent.
Magnesia, Mg O	1.32	" "
Ferrous oxide, Fe O	1.07	" "
Carbonic oxide, CO_2	42.59	" "
Silica, Si O_2	2.03	" "
	100.00	

As dilute chlorhydric acid extracts a large part, if not all, of the ferrous salt, and as the hardness of the silicate observed in the rock is greater than that of ordinary hydrated magnesium silicate, I conclude that probably the magnesium and iron are mainly in the form of carbonates, and that the silica is combined chiefly with lime, thus:

Calcium carbonate, Ca CO_3	92.02	per cent.
Magnesium carbonate, Mg CO_3	2.77	" "
Ferrous carbonate, Fe CO_3	1.72	" "
Calcium silicate, (and silica?) { Ca O	1.46	" "
{ Si O_2	2.03	" "
	100.00	

In this specimen the silicification had not been great. I presume specimens could be found showing two or three times as much silicate; and it must be borne in mind that a silicate formed in the pores of a limestone by infiltration and double decomposition, would have many times the hardening and cementing power of the same amount of silicate mechanically mixed

with the limestone ingredients at the time of deposition—a fact illustrated and applied in the manufacture of the Ransom artificial stone. The small amount of magnesium carbonate hardly indicates metamorphosis, as nearly all limestones contain as much. Indeed, in view of Dr. T. S. Hunt's researches, (Chem. and Geolog. Essays, 2d ed., pp. 138 and 86,) we should not expect a reaction to occur between a limestone and magnesium salts in solution. As the spring water contains no iron whatever, the ferrous carbonate was probably an original constituent of the stone.

The only metamorphosis, then, indicated by this analysis, is that resulting in the formation of three to four per cent. of silicate of lime—a small amount comparatively, but sufficient to impart to the stone a hardness plainly superior to that of ordinary limestone.

In conclusion, my explanation for the existence of the mound is, briefly, that the limestone strata constituting the present mound were once continuous across the Solomon valley, and formed the bed of that river; that the Great Spirit spring, then entirely submerged, added its mite upward through the river bottom to the mighty flood above; that the alkaline silicate of the spring water gradually effected the partial silicification of the limestone bed in all directions, within a certain radius, so hardening and cementing that portion as to enable it to withstand the eroding action of the river, when, having subsided to the limits of the "lower bottom," it disintegrated and washed away the unchanged limestone, leaving the preserved portion (upon the further subsidence of the waters to their present bed) no longer an islet, but a mound upon dry land—a monument to the power of the chemical agencies at work in nature's laboratory.

SINK-HOLES IN WABAUNSEE COUNTY.

BY JOSEPH SAVAGE.

While on a visit to Wabaunsee county during the summer of 1879, my attention was directed to a series of sink-holes which occur near the southern line of the county, some four or five miles northwest of Washara post-office. These sink-holes occupy a space of about four miles in extent from east to west, and a much narrower limit from north to south. They occur upon high prairie, the highest, in fact, in all that region. The surface upon which the sink-holes are situated is quite level, and would make good arable land for cultivation. The sink-holes pass through two rock formations, both of impure limestone. The uppermost formation is about two feet in thickness, while the lower one is four or five feet thick and fifteen or twenty feet below the surface. The sinks pass through both of these strata and the intervening clays, and the subterranean caverns are found below the lower rock formation.

At my request, these sink-holes have been partially explored during the past summer by Mr. S. N. Hills and my brother, Mr. F. Savage. They found the passage-way partially choked up with loose stones, but when fairly down they found a series of caverns of considerable dimensions. The caves were ornamented with numerous stalactites and stalagmites, and one little grotto of columnar structure was so finely scalloped and finished, as to almost if not quite excel in beauty of finish any statuary work of man's device. The apparent beauty of this little grotto was no doubt much enhanced by the dim lantern-light, as well as by the mineral waters constantly dripping over its outer surface. Quite a quantity of loose bones were found in these caverns, showing that they were the frequent habitation of wolves and other wild animals.

The cause of these sink-holes seems to have been in the loose, friable nature of the rock formation which surrounds them, and their surface indications are shown by depressions from forty to eighty feet in diameter; hence, as will be readily seen, the water during heavy rains concentrated and ran into them, causing wet-weather springs along the adjoining drains and ravines.

In a State so richly endowed as we are with thick beds of limestone, one would naturally expect to find numerous sink-holes and openings along our high prairie lands. These openings have been observed in a small way by the writer in Douglas county, and others of like character are found in Barton county; and it may be presumed that many other counties will contain them, when a more careful scientific survey is instituted.

LIST OF MINERALS FOUND IN KANSAS.

BY B. F. MUDGE, A. M.

The monotonous geology of Kansas does not allow a great variety in its minerals. The following list includes nearly all found in the State:

1. Alum.
2. Common salt.
3. Glauber's salt, sulphate of soda.
4. Epsom salts.
5. Nitre.
6. Copperas.
7. Gypsum, massive.
   - Selenite.
   - Fibrous.
   - Pearl spar.
   - Alabaster.
8. Calcite, or calc spar.
   - Chalk.
   - Oolitic.
   - Satin spar.
   - Stalagmite.
   - Marl.
9. Dolomite, or rhomb spar.
   - Magnesian limestone.
10. Iron.
    - Spathic.
    - Pyrites.
    - Oxid.
    - Hematite.

11. Barytes, or heavy spar.
12. Zinc, or blende.
    Carbonate, or cerussite.
    Silicate, or calamine.
13. Mica.
14. Feldspar.
15. Hornblende.
16. Spinel, ruby.
17. Manganese.
    Dendrites, or forest rock.
18. Quartz, flint.
    Agate.
    Carnelian.
    Chalcedony.
    Jasper.
    Chert.
    Amethyst.
19. Silver.
20. Copper.
21. Lead, galena.
22. Zinc, blende, or blackjack.
    Calamine.
    Cerussite.
23. Sulphur.

1. *Alum* is found occasionally in small crystals, in Wabaunsee, Saline, Dickinson, Clay and Republic and some other counties. It is usually associated with gypsum, sulphur, epsom and Glauber's salts, and results from decomposition of shales.

2. *Common salt* is found in springs and marshes, as can be seen in detail in my article on Geology, in the Kansas Agricultural Report, 1879–80, page 79. In the southern counties, in the valley of the Cimarron river, it is found in beds, in fine crystals.

3 and 4. Found wherever we have number one.

5. *Nitre—Nitrate of Potash.* This is the substance (especially when associated with salt and lime) which is called "alkali." It is less common than is usually supposed. We have found it in the western part of the State, but the quantity is not large.

6. *Copperas* is found in some of the coal seams, attending the decomposition of iron pyrites.

7. *Gypsum* is found, at least in small quantities, in half the counties of Kansas. The most beautiful cabinet specimens are found in the western portion of the State, in the valleys of the Smoky Hill and Saline rivers. It there presents fine, leaf-like clusters of crystals, sometimes as many as one thousand in a sheet. Single clear crystals are most common in Saline valley, in Ellis county. Pearlspar and alabaster are rare, the latter of poor quality. In southeastern Kansas, in the valley of the Cimarron, fine transparent sheets of selenite are obtained, which sometimes contains a jet black rhombic crystal.

8. *Calc Spar*, or *Carbonate of Lime*, is very common in the carboniferous and middle cretaceous deposits, in a great variety of crystals. The finest specimens are found at the lead and zinc mines in Cherokee county. In the carboniferous deposits the crystals are not large, lining small cavities, and not infrequently the inside of fossil shells. In the western part of Riley county is a stratum of calcareous shale which produces geodes. This deposit continues northeast and southwesterly into the adjoining counties. In the Niobrara chalk deposit it forms veins, filling fissures a foot wide and hun-

dreds of feet in length, the center sometimes containing large sheets of crystals accompanied by barytes. These have, by some persons, been taken for quartz veins, although entirely different in elementary composition. Strata of chalk, ten feet in thickness, have been taken from the Niobrara. Oolite is found in Johnson county; satin spar, in Cherokee county and at the Great Spirit spring; stalactite, in the caves at the southeastern part of Cherokee county, with stalagmite.

9. *Dolomite*, in rhombic crystals, occurs in the subcarboniferous, in Cherokee county. Magnesian limestone, in strata four or five feet thick, in the hills west of Lawrence, and near Fort Scott, but most of the limestone in the State called magnesian is not, but is carbonate of lime.

10. *Iron Pyrites* is found in almost every part of the State. Spathic iron, hematite and oxid of iron are not uncommon, but in too small quantities to be of market value.

11. *Barytes*, or *Heavy Spar*, in fine crystals, is found in Wallace county—the best near Sheridan station; also in Ellis, Nemaha, Ness and Brown counties. The latter is in beautiful flat crystals, of a light pink color.

12. *Zinc Blende*, with cerussite and calamine, furnishes fine crystals in a variety of forms and colors, from the mines of Cherokee county. Some specimens equal in beauty any from Europe.

13, 14, 15. *Mica, Feldspar* and *Hornblende* are not found *in situ* in Kansas, and only occur in the drift, and all are in small, inferior specimens.

16. *Spinel Ruby* was obtained by the writer, in the northern part of Riley county, in a stratum of fine clay shale. The crystals were small and full of fractures, rendering them unfit for jewelry. One was shown me, said to have been found near Milford, which was one-third of an inch across, and of clear, fine grain, which would make a lovely ornament.

17. *Manganese*, in the form of dendrites or "forest rock," is common from all parts of the limestone deposits.

18. *Quartz* cannot be considered common in the State, but small crystals are found in every county covered by the carboniferous deposits. They sometimes occur as small geodes, and occasionally line the cavities of fossils. Chert is common in some of the lime strata, and in such cases follow the beds across the State. Agate, carnelian, chalcedony and jasper are found occasionally in the sand-bars of our streams, and belong to our drift deposits. Amethyst in fine crystals is found in the small area covered by the metamorphic rocks of Woodson county.

19. *Silver*, but in only a few ounces to the ton, has been discovered at the lead mines. It has never been obtained except in such connection.

20. *Copper* only occurs in very small quantities with iron pyrites.

21, 22. For *Lead* and *Zinc*, see Geological article, in Agricultural Report.

COLOR-BLINDNESS, AND RAILWAY ACCIDENTS.

BY JOHN FEE, M. D.

The visual defect known as Daltonism, or color-blindness, has associated with it two sides — the one theoretical, the other practical. Viewed from a theoretical standpoint, it is connected with the wonderful phenomena of light and its properties, and with the sensitiveness of nerve matter in responding to this imponderable, and, as yet, scarcely understood agent, yet the means of our knowledge of external nature. As a practical topic, it is useful to those unfortunate individuals who, on account of their inability to perceive colors, are unfitted for many avocations, such as painters, artists, or for employment on board of ships, and on railways, in capacities in which they must display and read the language of signals. This practical phase of this subject presents an important question in forensic discussions, when chemists are giving expert testimony, on which depends the life of men charged with crime. No court ought at the present day receive the testimony of any chemist as an expert witness until it has been shown by sworn testimony that he has been tested for color-blindness. In this day of railways, when every one expects to travel, and does almost weekly or monthly use the railway car, the subject of color-blindness becomes of intense interest, and every person has a right to inquire whether this visual irregularity does endanger his safety and his life. I shall therefore treat this subject from a double view, viz., theoretical and practical. This subject may be said to be new in this country, and, in fact, it is only within the last decade that it has created any agitation in the scientific world. It is true, the existence of this deformity has been known for nearly a century, but prior to 1794 it had not received the investigation of a scientist. At this time, Dalton, the celebrated English chemist, discovered that he was color-blind, or rather red-blind, and that he did not see the solar spectrum as others saw it. This discovery of Dalton, and his investigations, secured for this irregularity the name of Daltonism, which is the favorite term of the French at the present day for color-blindness.

From Dalton's investigations, in 1794, until 1837, there is scarcely anything written on the subject. It seems to have been almost forgotten. In 1837, Dr. Seebeck, of Berlin, revived the subject of color-blindness, and reinvestigated it, and invented tests for determining the frequency and extent of this defect. In 1840, Dr. Isaac Hays, editor of the *American Journal of Medical Science*, published a paper entitled "The Impossibility of Distinguishing Colors;" and in 1845, Dr. Pliny Earle published in the same journal the report of a singular history of the color-blindness of five generations in his own family. In 1855, George Wilson, Professor of Technology in the University of Edinburgh, published the first practical work on the subject. Wilson's researches were made in view of determining the influence of color-

blindness in producing accidents on railways and at sea; and so thoroughly did he discuss this subject, that the Great Northern Railway compelled its employés to furnish satisfactory evidence of the perfection of their color sense. The wide-spread interest on this subject, and its agitation at the present time, are due mainly to the efforts of Prof. F. Holmgren, teacher of physiology in the University of Upsala, Sweden. He treats this subject from all standpoints—historical, theoretical and practical, and gives specific instructions for using colored worsteds for testing the color sense, which is everywhere known as the Holmgren method. The Professor has tested by his method great numbers of students, soldiers and railroad employés, and gives statistical results. In his native country, such has been the interest which his labors have awakened, that the Swedish Government has caused to be discharged from the railway service all persons found with impaired color sense. His book was quickly translated into the leading tongues of Europe, and into English by the Smithsonian Institution. The number of foreign scientists engaged in the study of this subject are too numerous to be mentioned, and I only insert here the names of Professors Donders, Mauthner, Hering and Helmholtz. This historical outline would be imperfect if I were not to add the name of Prof. B. Joy Jeffries, of Boston, who has written, in addition to numerous essays and reports on this subject, a work entitled "Color-Blindness: Its Dangers and Detection." This is the most exhaustive treatise on this visual irregularity in our language; and, besides the experiments and original researches of the author, contains a compilation of most of our knowledge on the subject up to the time of its publication, in the early part of the present year (1880).

What then is color-blindness? Is it the absence of the perception of light? Is it a disease, congenital or acquired? Is it an objective or subjective defect?—an imperfection of the mind, or of its visual apparatus? Color-blindness is not blindness in the ordinary sense of the word. The visual apparatus is perfect as an optical instrument, and the person has a natural perception of light, and of the form and outline of objects. It is inability to perceive certain colors, usually red and green, and tints of the same; so that the individual cannot distinguish the difference between the color of the leaves of a tree and its fruit. "The color-blind, however, see white and black, and their intermediate and compound, gray, provided they are free from alloy with other colors, precisely as others do."

Again, there are two colors properly so called which they see, namely, yellow and blue, which also if unalloyed they see in the normal manner. But these are the only colors of which they have any sensation, and hence their defect has been called by Sir John Herschel *dichromic vision.* ("Color-Blindness, Its Dangers and Detection," by B. Joy Jeffries, page 42.)

Here we digress for a moment to state that the evolutionists claim to find in the existence of this defect evidence of their favorite doctrine. According to Geiger and others, what would now be color-blindness was the normal

condition of our remote ancestors; the sensibility to colors enjoyed by the present generation is the hereditary result of education prolonged through many generations; in other words, the color sense has been developed by a process of evolution. This theory, developed some years ago by Geiger, who has recently died, has been recently developed at considerable length by Hugo Magnus, Professor of Ophthalmology in the University of Breslau. Magnus divides the colors of the spectrum into three classes: those richest in light, red, orange and yellow; that which has a medium degree of luminosity, green; and those which are feeblest in light, violet, indigo and blue; and argues ingeniously and learnedly to show that the advancing ages acquired each in turn. He maintains that primitive man possessed only the sense of light; that red was the first and violet the last color to be recognized, and that it is not impossible that our descendants may acquire the appreciation of colors that escape the present generation. Geiger stated that the Rig Veda contained no mention of green, blue or violet, and similar statements have been made of the Koran and of the Bible. Magnus says that Xenophon saw only three colors—red, purple and greenish-yellow, in the rainbow, and that the Homeric poems belong to the same color period, as they confound green with yellow. The mention of the Homeric age brings Mr. Gladstone to his feet, who fully adopts the views of Magnus, and shows that Homer perceived red and yellow, but confused green with yellow, and blue with black. ("American Journal of the Medical Sciences," October, 1878, page 474.) We have not time to investigate the Darwinian theory, and pass on.

There are two leading theories in regard to color-blindness, which we shall now examine. The oldest and most popular doctrine is known as the Young-Helmholtz theory, so named after Young, the English physicist, who first taught it, and called Helmholtz, because after it had been forgotten it was rescued from forgetfulness by Prof. Helmholtz, of Berlin. This theory recognizes three base colors—red, green and violet, and consequently three kinds of corresponding elements in the organ of the optic nerve, elements respectively perceiving red, green and violet. "Objective homogeneous light excites these three fibers in varying degree, according to the wave-lengths. The red perceptive fibers will be most strongly stimulated by light of the greatest wave-length, the green perceptive by light of medium wave-length, and the violet perceptive by light of the shortest wave-length." Prof. Helmholtz is not certain, however, whether there are three kinds of nerve filaments proceeding from the visual cones of the retina, or whether there are three kinds of nerve action in each nerve filament. He says:

"Perhaps there will be much objection to this hypothesis from the number of the necessary nerve fibers or nerve terminations being tripled, in comparison with the common theory in which every individual nerve carries all possible color stimulants. I do not think, however, in this respect, Young's theory is in opposition to any anatomical facts, since we know nothing of the number of transmitting fibers; and then, besides, there are a number of mi-

croscopic elements present, the special function of which we do not as yet know. Moreover, this is not the most essential part in Young's hypothesis. That seems to me to be the presenting of color sensations as composed of three wholly independent actions in the nerve substance. It is not absolutely necessary to suppose separate nerve fibers for these separate nerve sensations. The same value of Young's hypothesis in this explanation is shown, if we suppose that in each individual fiber three different and independent actions may take place. Since, however, the form of the hypothesis, as originally proposed by Young, is capable of a more definite presentation and expression than such a modification of it would allow, we will in view of its description retain the original and plainer form. Moreover, the physical phenomena of nerve stimulation, namely, the electro-motor, are not marked in the sensitive nerves and motor nerves by such a variation in action as would necessarily be the case if each nerve fiber transmitted all color sensations. By Young's hypothesis we may apply to the optic nerve the conception of the mechanism of stimulation and conduction which we have derived from the study of the phenomena of the motor nerves. This we could not do, if we must admit that each optic nerve fiber is to have three qualitatively different conditions of stimulation, without mutual interference. Young's hypothesis is only a more special carrying-out of the doctrine of the specific energies of the senses. As the sense of touch and the sense of sight in the eye have evidently separate nerve fibers, so is the same claimed for the sensation of the several base colors. The choice of the base colors is somewhat arbitrary. Any three colors could have been chosen whose combination produces white light. So far as I see, at present, there is no other way of determining the base colors than by the examination of the color-blind." (Jeffries Op. Cit., page 28.)

In support of the Young-Helmholtz theory, its advocates offer these additional physiological facts: "Around the point of best vision, in the center of the retina, is a zone, where we perceive all of the three so-called base colors—red, green and violet. Outside of this is another zone, in which we have a perception of only two colors, namely, green and violet; and again, beyond this, and more externally on the retina, only blue or violet is perceived." The advocates of the Young-Helmholtz hypothesis hold, therefore, to three kinds of color-blindness—red blindness, green blindness and violet blindness. For the present we dismiss the Young-Helmholtz theory, and take up that of Prof. Hering, of Prague. I copy from the *American Journal of Medical Sciences* Prof. Hering's theory, as stated by Prof. Mauthner:

"According to this theory, vision is produced by the action of light on three separate and distinct chemical substances, which he calls the black-white, the red-green and the blue-yellow. Sight acts on these substances by assimilation and dissimilation. Dissimilation of the black-white substance produces the sensation of white, its assimilation black. As regards the red-green and blue-yellow substances, Hering is undecided as to the D and A

colors. But if we take the red and blue as the D colors, the D of the red-green substance would produce red, its A green, and the D of the blue-yellow substance would call forth blue, and its regeneration yellow. All the rays of the solar spectrum act in a dissimilating manner on the black-white substance: that is, they produce the sensation of white, but in different degrees, the yellow acting most powerfully, the others decreasing in power toward the two ends of the spectrum. On the blue-yellow and red-green substances there are certain rays which act in a dissimilating manner, some in an assimilating manner, and some not at all. If the A and D of the black-white substance are of equal intensity, the result is gray. If the A and D of the red-green and blue-yellow substances are equal, the result is negative as to color, and there only remains the dissimilating action of those colors on the black-white substance, that is white. (Amer. Jour. Med. Sci., Oct. 1880, page 532.) According to Hering, therefore, the so-called complementary colors are not complementary, but on the contrary, antagonistic. By their mixture they do not produce white, but being neutralized they allow the white sensation, which they all produce, in a greater or less degree, to come prominently forward. The phenomena of color-blindness, as based on this theory, are as follows: In the achromatrope all the rays of whatever refrangibility, acting in a dissimilating manner, white or its shade, gray, is produced. In the dichromatrope, besides the black-white there is only one other substance that can be acted on by the different color rays. If this is the blue-yellow (constituting red-green blindness), the red-yellow and green light act in a dissimilating manner, and the blue in an assimilating manner. The most strongly dissimilating color is yellow; the others are varying—sometimes the red is stronger than the green, and *vice versa*. To some of the light-waves at the red end of the spectrum, the colored as well as the black-white substance is insensible. In the same way, in case of blue-yellow blindness, where there is only the red-green substance, in addition to the black-white substance, the red-yellow and blue lights act dissimilatingly, and the green assimilatingly. The D color is red, the A color green, and there are certain color rays at the blue end of the spectrum which do not act on either one of the substances. In this case we should have a shortening of the spectrum at the blue end; as in the former case, there would be a shortening of the red end. As an A and D of equal intensity of any one-color substance would result in a total abolition of both colors, so where we have such an action in the case of a dichromatrope, there would be no color perception at all, but only the sensation produced by the action of light on the black-white substance, that is, gray. It is on this account that certain shades of color appear as gray to the dicromatrope. Purple and bluish green are the colors which most dichromatropes confound with gray; but as the dissimilative power of any is not the same in all dichromatropes, we should not expect to find, according to this theory, the same shades of those colors to be invariably confounded with gray. To one, a certain shade would

appear gray, which to another would be blue, and to a third yellow, owing, of course, to the preponderating color after the action of the opposing colors.

"It will be seen, from this point of view, there can be but two forms of color-blindness, according as the one or the other of the color substances is lacking, but as such color substance, by its A or D action, represents two colors, a color-blind individual must be either a dichromatrope or an achromatrope. Hering, therefore, recognizes only red-green blindness, or blue-yellow vision, and blue-yellow blindness and red-green vision, and achromatopsia, or simply the perception of light and darkness." (See Amer. Jour. Med. Sciences, Oct. 1880, page 533.)

To my mind these theories seem ingenious but unsatisfactory. The latter is perhaps more serviceable as a hypothesis. The idea of the existence of separate nerve filaments for the conduction of the different waves of the base colors has no evidence in microscopic anatomy. Once accepted, we shall have a convenient hypothesis for explaining all the qualitative functions of the other cranial nerves. We can hold that the filaments of the olfactory nerves correspond in unlike character, and qualitatively to the different odors that excite them. The same reasoning would be applied to the auditory nerves, and to the gustatory branch of the pneumogastric. As to the different color zones of the retina, we can explain, by saying they are the result of chromatic aberration. The mind perceives the colors where they really are, as the shorter rays first come to a focal point, and then disperse in circular waves over the retina. Further, we know that perception is a mental operation, and is subjective, and not the act of nerve filaments of conducting nerve matter, but is the functional act of the brain cells in which they terminate. Whatever properties there are in objects and light, for the formation of color, must be differentiated by the mind, or that part of it with which the color sense is associated. Late researches show conclusively that the different functions of the mind are associated with different areas of nerve matter, of the cortical substance of the brain, and that the congenital absence of one of these centers, or its destruction by disease, will abolish some functional action of the mind. These areas have been mapped out with considerable certainty as centers of motion and sensation to the various groups of the muscular system; and other important functional areas have also been discovered, such as the speech center. Again, it has long been known that color, light and form have different areas of perception, and that both the perception of light and form can exist independently of the perception of color. The most reasonable hypothesis, or to my mind conclusive explanation of color-blindness, is, that it is a congenital defect, and results from the non-development of the area for the perception of color.

The influence of heredity on mental function has been greatly overlooked. I hold that mental power is both quantitatively and qualitatively more influenced by heredity than by outside influences or education. In a word, I hold that Lock's teachings as to the source of mental power are contradicted

by the heredity of genius, the heredity of crime, and all the phenomena of insanity. Color-blindness is, then, a congenital defect, a defect of involution, and consequently cannot be remedied by education. Several French writers have claimed that by systematic efforts the color sense could be developed in the color-blind, but it is evident from their writings that they have confounded a weak or impaired sense or knowledge of color with color-blindness. Persons who are slow and uncertain in designating color can be educated in chromatics, but the color-blind never. And here permit me to make an observation, in digressing from my subject; it is this: the hardest blow dealt to evolutionists theoretically is, that a qualitative mental function being absent, it cannot be developed by efforts at education; but if a mental characteristic exist, however weak and small, it may always be educated. Hence, it would seem that evolution must always be qualitatively what has first been involuted.

Let us now consider briefly the relation of color-blindness to railway accidents. It is well known that colored signals are absolutely necessary to the management of railways, particularly at night. It has been proposed to substitute form for light, for signals; but the appreciation of light is so much quicker and easier than that of form, that the change has been found impracticable. The ability, therefore, to determine the language of colored signal lights is absolutely necessary to train-men; and consequently, the safety of trains is endangered just in proportion to the number of employés who are defective in the color sense. The extent of this visual deformity can be tolerably accurately determined by statistics. "Dr. Fontenoy found thirty-one color-blind out of 1,084 railroad employés of Denmark, or 2.87 per cent. Prof. Donders, of Utrecht, Holland, found, among 2,300 railroad employés, 152 color-blind. Dr. Stetling, of Cassel, Germany, found, out of 400 railroad employés, six per cent. color-blind. Dr. Krohm, in Finland, found, among 1,200 railroad employés, sixty, or five per cent, color-blind. Dr. Holmgren found, among the employés on the railroads in Sweden, 4.8 per cent. color-blind." (Jeffries' Op. Cit., p. 143.) From the number of railroad employés tested for the color sense in Europe, and persons examined in this country in the schools, we can assert that there are five per cent. of the male population absolutely color-blind, and about five per cent. in addition who have an imperfect perception of color. It is also known that the majority of persons who have this defect are unaware of it, or do not know the extent of their deformity. It is apparent, therefore, that this imperfection must be a great factor in the production of collisions and other accidents on railways. On most railways, red lights signify "danger," white or yellow light, "track clear," and green light, at way-stations, "stop for orders." No person will deny that a certain number of accidents will happen from carelessness and inattention, especially where great numbers of persons are engaged; and if this is so, how can accidents fail to occur among a vast number of persons, of whom five per cent. are absolutely incapacitated for discharg-

ing the duties assigned to them? That color-blindness is the source of accidents and calamities on railroads, in which property and life are sacrificed, is as apparent as any fact in pure mathematics.

How shall railway accidents and dangers be prevented? Simply by seeing that no men who have this visual defect be employed as train-men; that is, in the capacity of engineer, stoker, brakeman, conductor, or switch-man. This result can be secured by examinations, as first suggested by Wilson in 1855. It is accomplished, according to Prof. Holmgren's method, by having the person to be tested match colored worsteds. For the purpose of making the examinations, colored worsteds are procured, and placed in a pile on a table or large plane surface. The examinations are made in daylight. "The selection of worsteds includes red orange, yellow, yellow green, pure green, blue; violet, purple pink, brown, gray; several shades of each color, and at least five gradations of each tint, from the deepest to the lightest. Green and gray, several kinds each of pink, blue and violet, and the pale-gray shades of brown, yellow, red and pink, must especially be well represented.* The colors are divided into sample colors, consisting of green, purple and red, and confusion colors, made of every shade and tint of the solar spectrum. The first test consists in matching the sample green color. He who places besides the sample color one of the colors of confusion—that is to say, finds that it resembles the test color—is color-blind. He who, without being quite guilty of this confusion, evinces a manifest disposition to do so, has a feeble chromatic sense. Second test: A purple skein is presented. The color chosen must be between the deepest and lightest shades of the scale. Diagnosis: He who in the second test selects with purple only blue and violet, or one of them, is completely *red-blind.* He who in the second test selects with purple only green and gray, or one of them, is completely green-blind. Test third: The red skein is presented to the subject. It is necessary to have a vivid red color, like the red flag used as signals on railways. This test, which is applied only to those completely color-blind, should be continued until the person examined has placed beside the specimen all the skeins belonging to this shade, or the greater part, or else, separately, one or several colors of confusion. The red-blind then chooses, besides the red, green and brown shades, which to the normal sense seem darker than red. On the other hand, the green-blind selects opposite shades which appear lighter than red. Violet-blindness will be recognized by a genuine confusion of purple, red and orange, in the second test." (See "Color-Blindness," by F. Holmgren, page 185—Report of Smithsonian Institution, 1878.)

In conclusion, Mr. President, permit me to say that the principal object I have had in view in preparing this paper has been to interest this Academy in the subject of color-blindness, and through it the Legislature and his Excellency the Governor of the great commonwealth of Kansas. I believe that when this subject is properly presented to the legislators of your State,

*The word purple here does not designate the color that has that name in this country. It is known to us as Victoria rose, and is said to be carmine diluted with white.

that some protective legislation can be secured against railroad collisions, so as to render transit on railways less perilous to life. I need not point out to you the numerous so-called accidents and catastrophes that have been chronicled in the United States during the present year. They are not altogether the result of carelessness or criminal negligence, as too often supposed, but result from the visual defect which I have just pointed out. As men of science, I appeal to you who can take a broader view of the subject than the employés of the railways, or even the men whose capital and wealth are invested in these corporations. I know that any legislation on this subject will be characterized as visionary, as yielding to the imagination of impractical men. But our mission is missionary. It is our duty to create, to mould public opinion, and not to vacillate before the scoffs and jeers of those who hold pure progressive science in ridicule. In many places in Europe stringent legislation exists in regard to the employing of the color-blind by railway corporations. In other countries, the railway corporations have provided the necessary safeguards without the compulsion of legislation. In our country, the National Government has not been slow to appreciate the importance of this subject. By order of the Surgeon General of the navy, all persons connected with the navy have been tested for the color sense, and a record of all defects of this kind are filed with the Department. I presume that Congress will be asked to order the discharge from the navy of every person found color-blind. Hon. John Sherman has issued orders to all inspectors of licenses to have all pilots of steam vessels tested for color-blindness, and to withhold licenses from all persons affected with this defect. In the army all recruits are examined, and all found color-blind are marked unfit for the signal corps.

The agitation of this subject has already commenced in several of our State Legislatures, thanks to the untiring efforts of Dr. Joy Jeffries, of Boston. Massachusetts is deliberating before and discussing the policy of legislation. Connecticut has already passed a stringent and ample law controlling railway corporations in regard to employing the color-blind. Its character may be inferred from the second section of the law, which reads as follows: "Any railroad company or trustee operating any railroad in this State, employing, after the first day of October next, in any of the capacities specified in the second section of this act, any person who does not possess a certificate of freedom from color-blindness, and possession of normal visual power, duly issued in accordance with the provisions of this act, or knowingly employing in any such capacities any person whose certificate has been revoked by the examiners, shall, for each and every offense, be punished by a fine of not less than two hundred dollars nor more than one thousand dollars." Approved March 25, 1880.

Mr. President, I trust the time is not far distant when the agitation of this law will invade this temple of justice and wisdom. From its sacred precincts numberless edicts have gone forth in defense of humanity, which have given

the commonwealth of Kansas the proudest position in the sisterhood of the Union. I am happy in believing that there is no subject that concerns the safety of human life, too lowly or insignificant to be introduced here; nor is there any prejudice or vice, or evil or crime, so insolent or contumelious as to intimidate the Goddess of Liberty and Humanity, who has her home within this temple.

THE RAINFALL IN ITS RELATIONS TO KANSAS FARMING.

BY H. R. HILTON.

Political economists tell us that the foundation of the wealth and prosperity of a nation lies in the productions of its soil.

Science tells us that the successful production of crops is dependent principally on the climate, or the proper distribution of heat and moisture.

The climate of a country bears the same relation to its agriculture that the products of the soil do to its general prosperity; and successful farming must rely as fully on a properly-adjusted supply of moisture and heat, as the prosperous State or Nation does on its agricultural production. The farmer may bring drainage, fertilizers and a thorough system of cultivation to his aid, but his success is, after all, proportioned to the kind of season with which he has been favored. That system of farming approaches nearest perfection, that takes into consideration the varieties of climate under which the system is to be carried on, as well as the varieties of soil to be tilled, and engages in the cultivation only of such products as are adapted to both soil and climate.

The resources of Kansas are almost exclusively agricultural, and in Kansas agriculture is specially dependent on the climate. Every business interest in the State is affected, favorably or adversely, as our crop seasons are good or bad; and a thorough and intelligent knowledge of our climate is one that concerns the welfare of our State and every resident in it.

That the system of cultivation and variety of crops in this State should, in so many instances, be so much at variance with the climate and the soil, must be attributed not so much to ignorance on the part of our farmers, as to the fact that both soil and climate were new to them, and different from that to which they had been accustomed in other States further to the East. They had no precedent to follow, and naturally adopted whatever rotation of crops or whatever system of cultivation they had been accustomed to at their former homes. It required, and is still requiring, years of experiment to determine what crops must be abandoned and what adopted, and under what plan of cultivation the best results can be secured. The first ten years of the settlement of any portion of our State may be termed the experimental stage of its history, and many failures have to be recorded and drawbacks over-

come before experiments determine what system of cultivation and variety of crops are best adapted to the wants of that particular section of the State.

In passing over the State from east to west, we find that a gradual change in the soil takes place—that of eastern Kansas being as distinct from the soil of the western counties, as is found in the climate of these respective localities; while in central Kansas we find the soil to be a compromise between the two extremes.

The soil of eastern Kansas is a black loam, resting on a clay formation; that of central Kansas a dark, sandy loam, resting on a porous marl clay formation; while that of western Kansas has a still more sandy surface soil and more porous subsoil. This is the general subdivision, subject to occasional variations. As a rule, the surface soil grows deeper and the subsoil more porous, as we pass from the east towards the west.

The rainfall is graduated from east to west across the State, with as much regularity as the soil, the precipitation being about one-third greater in eastern Kansas than in western, and about one-fifth greater than in central Kansas. But here a law of compensation enters in to modify this difference, the moisture-absorbing and retaining qualities of the soil being much greater in central and western Kansas than that of the eastern portion of the State. As an illustration of this point, let us take a tract of cultivated land with a black-loam surface soil one foot deep, resting on a clayey subsoil. On this tract of land two inches of rain falls. One-half is sufficient to thoroughly saturate the surface soil down to the clay; the balance is rejected for want of capacity in the soil to store it, and in consequene this surplus flows off into the stream.

Let us now take another tract of sandy loam, two feet deep, resting on a porous subsoil, on which two inches of rain falls. This soil, having double the storing capacity of the tract first named, receives all the rain, and instead of wasting half, stores the full amount for future use.

The natural deduction from this would be, that the soil two feet deep, storing a double quantity of moisture, will be more than twice as long in parting with it; not only because it holds more of it, but because it is stored further from the surface and from the influences of the sun's heat, drying winds, and consequent evaporation.

The experience of Eastern farmers who have carefully noted the effects of drainage on their soil is, that a tract of land on which the surface soil has been deepened by drainage will produce crops on one-half the rainfall that was necessary prior to drainage; or in other words, by doubling the capacity of the reservoir for storing and retaining the moisture in the soil, a much less quantity of rainfall is now necessary to produce like results.

It would seem to follow from this, that the amount of rainfall sufficient to raise crops in one locality may be either too much or too little for some other localities having a more or less absorptive soil.

For instance, if thirty-five inches be the amount of annual rainfall neces-

sary to farm successfully in the State of Illinois, eastern Kansas, with its better-drained soil, will furnish as much moisture to plant-life on twenty-five inches of rainfall per annum, and western Kansas as much on a fall of twenty inches; and if Illinois and eastern and western Kansas had a like amount of land under cultivation, I think the standard of sufficient rainfall for each would bear about the same relation to each other as the figures I have already quoted, based upon the theory already advanced, that for the purposes of comparison, the absorption and retentive qualities of the soil, and the amount of rain utilized, rather than the amount that falls, shall be taken into consideration. Had time permitted, I should have been pleased to show, by a series of experiments with glass tubes filled with soil, the absorptive qualities of the different varieties to which I have referred, and hope at some future time to have an opportunity to do so. Perhaps some of our State institutions will take this matter up, and give it a more thorough test than it would be possible for me to do.

By keeping in mind the peculiarities of our soil to which I have referred, we can, I think, better understand why cultivation of the soil has so materially changed the climate of our State; and to this subject I wish now to call your attention.

The source of our water supply is mainly in the Gulf of Mexico. This supply is transported hither in the form of aqueous vapor, by means of the great aërial currents that flow northward from the gulf with so little variation during the summer months, and here precipitated in the form of rain. Part of this is received and stored in the soil for the use of plant life, part is returned to the atmosphere by evaporation, and part is drained off into the streams, and carried back to the ocean, where it is again evaporated and returned to us by the aërial currents. Thus our water supply is making a continual circuit—flowing to the ocean as water, and returning therefrom as vapor.

As the wind currents are the mediums of conveyance of moisture from the ocean to the land, a knowledge of the laws that govern their direction is an important factor in the solution of our probable rain supply.

The summer winds of Kansas are mainly southerly, those from the southeast and south predominating over those from the southwest.

During the winter season, the winds blow from all points of the compass, the prevailing direction being from the west, northwest and north. The summer winds from the south are generally humid. The northerly and westerly winds are generally dry.

The steadiness of the wind breezes from the south during the summer season may be attributed to two causes. One, the trade winds from the northeast, flowing southwest toward the equator, south of the thirtieth parallel, strike against the mountain chain of Central America, and are deflected to the northwest, along the eastern slope of the mountains, and making a grand curve, return over Kansas as a south or southwest wind. The other cause

is the monsoon influence of the heat-radiating plains, which attracts the moist and cooler breezes from the ocean. These come to us as south or southeast winds. All of these southerly winds carry more or less moisture.

The same influence that brings to the Mississippi Valley States, parallel with Kansas, their supply of moisture, brings it to Kansas.

Our rainfall is less, simply because we offer less favorable conditions for precipitation. Supply these conditions, and our rainfall is measurably comparable with those States. Where the rainfall of Kansas is deficient, it is more a lack of the necessary conditions of soil, vegetation and local evaporation than a lack of humidity in the aërial currents passing over. The latter are rarely wanting in moisture, during the summer months. The conditions necessary to wring this moisture from the atmosphere are conspicuously absent over a large area of Kansas, and these are: deeply-plowed and well-cultivated fields, growing crops, larger area of trees, ponds of water, and ranker vegetation of all kinds more generally distributed. With these supplied, the question of the sufficiency of our rainfall will not be such a vexatious one as it is at present.

A comparison of the climate of the eastern half of Kansas, before and since it has been brought under man's civilizing influence, affords strong proof of the climatal changes brought about by settlement.

What Kansas is to-day west of the ninety-ninth meridian of longitude, all of Kansas lying west of Topeka was twenty-five years ago. Then the buffalo grass covered all the prairies, except along the streams, as far east as Topeka. Vegetation was scant, as the freighters across the plains in those days can testify. Immense herds of buffalo kept the surface tramped hard, and together with the sun-baking process that it underwent, rendered the soil impervious to rain, which it shed like a shingled roof. Prairie fires aided this petrifying process by burning off the sparse vegetation almost annually. Hot winds were a consequence of this exposed heat-radiating surface. The principal rain supply of the summer months was through the medium of thunder storms, of great severity. Precipitation took place at a high elevation, and was very rapid. Gentle showers and general rains, such as we are now frequently favored with, were then very rare. During the first ten years farming was attended with many difficulties and discouragements, on account of the seasons, and few believed that the frontier of settlement could ever be extended west of Topeka, except, perhaps, a short distance along the valleys. But in spite of these many discouragements of the climate, the pioneer settlers ventured first just outside the Missouri valley, then gradually westward, step by step, mile by mile, and each year saw a little further advance made upon the Great American Desert, until now we find the land possessed for 300 miles west of the Missouri river. And what has been the consequence of this possession? The plow has been actively at work, and the water-shedding roof on over 8,000,000 acres of land has been torn up; the soil has been tilled, and a storehouse provided for the rainfall that was

formerly wasted. Forest and fruit trees, millions in number, have been planted, proving a valuable climate-ameliorating accessory to the cultivated soil and ranker plant growth.

From these combined causes came an increased humidity of the atmosphere, and a more general diffusion of moisture from the new water supply held in reserve. Increased humidity was rapidly followed by plants and grasses that find their best development in a humid climate. The tall blue-stem grass, that could not withstand the dry, arid climate of the plains, now follows in the wake of the settlements, and takes possession of the soil, on which the short, wiry buffalo grass had so long flourished, because it alone was capable of sustaining life on a limited supply of moisture.

The tillage of the soil and growing of trees made the first breach in the arid climate; moisture was sufficiently increased to favor the growth of the blue-stem grasses. When these took possession, I believe their influence was greater than all other causes combined, because by covering the major portion of the country with a heavy coating, that greatly reduced radiation, they removed one of the most stubborn agencies that the pioneer had to contend with. It also, by penetrating the now shaded soil with its strong roots, caused the former surface-hardened roof to leak, and enabled the soil to drink in and retain moisture that had previously been denied it.

Cultivation, tree planting, mulching, change of grasses, prevention of wide-spreading and destructive fires — these are the great agencies that have wrought such a wonderful change in the climate of the eastern half of Kansas. Even if no more rain falls on the earth now than in the early days of the State's history, it is better distributed throughout the season. We have more gentle showers, more general rains, and while we may have as many thunder storms, they are not marked with the severity of the years that preceded the civilization of our soil and climate.

Our streams, that were then constantly fluctuating from dry river-beds to overflowed banks, now have a more even flow, not feeling the effects of heavy showers at once, and overflowing only in cases of extremely heavy rainfall. The moisture held in reserve by the heavy grasses and cultivated soil keeps the streams constantly supplied, and many of these that formerly contained water only a portion of the year, now flow permanently.

We have only to look around us, and note the grasses, the streams, the soil, products, and the changes in plant growth, to find that nature has furnished us the best possible evidence of the climatal changes that have taken place in our State, and all the statistical data we may compile are valuable only so far as they are corroborated by these evidences which nature presents to us.

Moist air is said to be three-fifths lighter than dry air at the same temperature. Cold dry air possesses greater density and weight than hot dry air.

In the pre-civilized days of Kansas, when vegetation was very sparse, the sun's rays poured down upon the unprotected surface, which, owing to its

hardness, absorbed the sun's heat to a very limited extent, and instead threw it off into the surrounding atmosphere, raising its temperature proportionately. The effect of this increased temperature was to set the air in motion. Cooler air rushed in to fill the vacuum, to be again heated and kept in motion.

There being comparatively no moisture in the ground to evaporate and moisten the surrounding air, it remained dry, and being of greater density than the moist currents above, a local stratum of hot air was formed between this moist current and the earth's surface. Being by reason of its greater weight unable to force its way through the lighter air above, its motion became lateral instead of upward; and on account of this lateral motion, the air, in passing over a large area of heated surface, became intensely heated. With the increased temperature came increased velocity, and hence the hot winds so prevalent on the plains many years ago, and now occasionally experienced on and beyond our frontier of settlements.

After sundown the earth, owing to its limited capacity for absorbing heat, cooled rapidly, and the surrounding atmosphere changed from a hot, dry stratum, to a cold one of greater density, but of diminished thickness.

My theory is, that this stratum of hot, dry air, next the earth's surface, insulates the ground from the moist aërial currents passing over. It is a bad conductor of electricity. Electric communications between the earth and the clouds are difficult to establish, because the earth, by reason of its dryness and lack of vegetation, offers no attraction. When an electric discharge from the clouds to the earth takes place, the resistance of the dry air makes its severity and destructiveness many times greater than would be the case were a good conductor provided; for the better the conductor, the more quietly and harmlessly are these discharges effected.

The atmosphere of the plains is highly electrical, but owing to the insulation referred to, discharges are more frequently made between cloud and cloud, than between the clouds and the earth. When a breach has been made in this insulation, and an electric discharge takes place between clouds and earth, it is generally violent, and followed by rapid condensation and heavy rainfall.

Atmospheric electricity is now believed by many to be a force generated by the liberation of latent heat, when the vapor in the air is precipitated into clouds, or clouds into rain; it is therefore a result, and not a cause, of such precipitation. I believe it, however, to be an important factor in the precipitation of the water held in the clouds, but in what exact way it acts beneficially, we can only surmise.

When the clouds are charged with positive, and the earth with negative electricity, discharges from one to the other invariably follow. The rapidity of the discharge through the air creates a vacuum which sets the air in motion. Its equilibrium has been disturbed, and before readjustment takes place, a portion of the moisture is condensed and parted with in the form of rain.

If I am correct in my theory of the stratification of the atmosphere, it is obvious that, in order to change the climate, we must remove the insulating stratum of dry air, and bring the earth and the moist currents of air more nearly in contact with each other.

We know that eastern Kansas had at one time a climate in many respects similar to that of western Kansas of to-day. We know that the climate of one-half of Kansas has been changed by the civilizing influences of man. Our soil has been surrounded by a new atmosphere. Material for evaporation is now supplied from the reservoirs provided for the reception of the rainfall. The heat imparted to the atmosphere by radiation now carries with it moisture evaporated from the soil; and this warm, humid air, on account of its expansiveness and consequent lightness, rises upwards into higher latitudes, displacing the colder and more dense atmosphere, which sinks to the surface to fill the vacuum created by the uprising current, which is in turn warmed, moistened and carried upward. These ascending and descending currents have a tendency to disturb the relative temperature and consequent equilibrium of the atmosphere. Such conditions favor condensation of the vapor in the air, and the more humid the ascending current the better the electric conductor.

The tendency of thunder storms to follow streams and timber belts may be attributed, I think, not so much to the elevation of the tree itself above the ground, as to the greater amount of humid air that is ascending from such timber belts, affording the most favorable conducting medium. Anything that will aid in increasing evaporation will aid in establishing better communications between the clouds and the earth, and insure a greater frequency of local showers during the summer season.

The mirage, so peculiar to our Western climate, seems to me to furnish excellent testimony regarding the existence of a local stratum of air, and its partial destruction afterward by settlement. The mirage I understand to be due to a ray of light refracted through three or more strata of air of different densities, lifting up into view objects lying below the horizon of our vision. In order, then, to produce the mirage, there must be stratification.

When Reno county was first occupied by settlers, about ten years ago, the buffalo grass covered the prairies, and the mirage could be seen on almost any summer day. Now it is a rare occurrence, because the settlement of the country, and the consequent change of vegetation, have reduced radiation, increased evaporation, and partially prevented stratification.

To increase our rainfall, then, we must do these two things: Reduce radiation and increase evaporation.

Many have an impression that by increasing the local evaporation we really provide the moisture from which we receive the rain. This I think a fallacy. We will undoubtedly get a small percentage of the amount evaporated back again in the form of rain, but we must depend mainly on the aqueous vapors brought to us from the Gulf of Mexico for our main supply

of rainfall. The local evaporation is valuable to us, because it furnishes the conditions necessary to wring from the atmosphere the moisture we want.

The water supply of timbered countries has been reduced by removing the timber, and again increased by replanting. Yet the annual supply of moisture in the atmosphere was not materially different in the years of a short water supply from those of abundance. The removal of the timber removed one of the essential conditions of rain precipitation, viz.: local evaporation. The replanting of the timber was simply the restoration of the desired condition.

Many of our residents feel discouraged on account of the severity of the drouth on our western frontier during 1879 and part of 1880. Were such drouths of frequent occurrence, it would, indeed, be discouraging, but it must be remembered, that its like was never known in the history of the Plains, and we only find a parallel to it for a shorter period in the drouth of 1860, when the pioneer settlers in this vicinity suffered about all that our frontier settlers have done in the past year. Such an extreme period of drouth we have no reason to anticipate oftener than once in every twenty years, although we are liable to periodic drouths on a smaller scale, the same as any other portion of our country. We must not, therefore, judge of the future by the experience of the past two years; we must take the average of a succession of years.

Within the past few months I have heard the wish often expressed that the western half of the State might be cut off from Kansas, and attached to some other State or Territory, so that we might not be compelled to shoulder the responsibility for the recent failure of crops on our western frontier, and consequently suffer in reputation.

The remark is a foolish one, and the authors will acknowledge it before they are many years older.

The rainfall will, in my opinion, never be so great in western Kansas as in eastern Kansas, but its soil requires less. I do not believe that western Kansas will ever be a general farming country in the sense that eastern Kansas is, but I do believe its natural resources are just as great.

We do not condemn eastern Kansas as a farming or fruit country because bananas and oranges cannot be successfully raised in it; nor do we condemn Florida because the products of a cold climate are not successfully produced there.

Our Western farmers have been experimenting in the past few years, and the stimulating effect of the recent drouth has not been without fruit. New discoveries are being made each season of some new plant more especially adapted to the climate and soil. The rapid development of the Egyptian, or rice corn, in the past two years, is a notable instance of this. The success and value of this new crop, and its ability to stand even as severe a drouth as that of this spring, has been shown beyond a doubt.

The successful and profitable manufacture of sugar from amber cane has been fully demonstrated by Mr. Bennyworth, at Larned, Pawnee county, this season. Mr. Bennyworth has spent about $25,000 in the experiment, and

while he failed to establish his works in time to use all his cane and make a financial success, he has accomplished enough to prove that the climate and soil of western Kansas are specially adapted to the raising and ripening of cane. This cane can be successfully raised in the dryest season, and no crop is more certain anywhere. An acre converted into sugar and syrups is estimated to yield from $75 to $100, on a fair yield. There are 10,000,000 acres of land west of the ninety-ninth meridian in this State that will produce $50 worth of sugar per acre, and in the production of it will support a larger population than is possible with any other Kansas crop. Broom corn is a successful crop in western Kansas, and one that, like sugar cane, encourages home manufactures. With a more thorough system of cultivation than that now practiced, wheat will be successfully raised four seasons out of five.

The sheep and cattle interests of western Kansas will always be the most important ones, and the success of millet and rice corn, as feeding crops, in that portion of the State, will stimulate the production of a better grade of beef and mutton than has heretofore come from the west.

With a diversified system of farming, each farmer producing a little of each of wheat, sugar cane, broom corn, millet, rice corn, vegetables, etc., and as much stock as they can conveniently handle, instead of confining themselves to one crop, there will be fewer cases of failure to record; but farmers of Kansas, east and west, must remember one thing, that in order to get the most advantage out of their present rain supply, they must plow deep; they must get below the hard upper crust; they must thoroughly pulverize the soil so that it will act as a mulch, and then they will increase the moisture-storing capacity of their soil, and practically make a great increase in the rainfall, by utilizing it to its fullest extent.

A good illustration of the value of such a system of farming, I found recently on the farm of W. H. Gill, of Pawnee county, one of the best cultivated farms in Kansas. In June, 1879, Mr. Gill plowed an eighty-acre field of old ground over eight inches deep, afterwards thoroughly fining the soil by frequent harrowing, and by heavy rolling just before seeding to wheat. After seeding, this field got one shower, and another in February following, when the wheat was again rolled. Both showers did not exceed an inch of rainfall, and yet from that field nine bushels per acre were harvested this year. If such a record can be made under such circumstances, it will be easily seen on what a small rainfall a successful crop of wheat can be raised, when cultivated according to Mr. Gill's method. This instance also illustrates the peculiar properties of this soil for absorbing and holding moisture.

During the first week in October last, rain fell for three consecutive days, almost without cessation, all over western Kansas, and Mr. Gill informs me that not a drop of that three days' rainfall ran off the surface of his plowed land, but all was received into the soil.

The irrigating ditch at Garden City, Sequoyah county, illustrates the same principle. While there last week, I saw fields of corn that would be considered fair in this vicinity, that had only been flooded once this season.

No one questions the fertility of the soil of Kansas, and owing to its fine natural drainage, it is less affected by excessive rains or excessive drouths than the heavy soils of the Mississippi valley States. Our rainy season is our crop-growing season; our dry season is our stock-feeding season.

Taking our average of the past ten years, our record as an agricultural State is equal to that of any State in the Union. The great diversity of our soil and climate brings within our reach the production of a great diversity of crops; and if we carefully observe and study all its peculiarities, with a view of adapting all our products to it, there is no good reason why Kansas should not be among the leading agricultural States, if not the leading one, of the Union.

ON THE MAGNETIC DECLINATION IN KANSAS FOR OCTOBER, 1880.

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It is required by the law of this State that each county surveyor shall "compare the magnetic with the true meridian at least four times a year, viz., between the first and fifteenth of January, April, July, and October," and shall report "to the Secretary of State, and" to "the President of the University of the State of Kansas." Up to the present year, this law has been, so far as I know, a dead letter. In September last, the President of the University asked me to take charge of the matter, and the results obtained are as follows. It is to be regretted that the discussion is so partial, but the small number of counties heard from — only 36, in a total of 75 organized counties — renders a complete summation impossible. The total number of reports for January is 12; for April, 13; for July, 14; for October, 36.

The following are the figures, arranged in alphabetical order of counties. I give only those for October, as the small number of reports for January, April and July render any conclusions for those months next to worthless:

Town.	*County.*	*Eastern Declination.*	*Town.*	*County.*	*Eastern Declination.*
Garnett,	Anderson,	10° 40′ E.	Council Grove,	Morris,	9° 20′
Great Bend,	Barton,	10 45 30″	Seneca,	Nemaha,	10 27
Concordia,	Cloud,	10 16	Bazine,	Ness,	11 30
Junction City,	Davis,	10 35	Norton,	Norton,	11 49
Lawrence,	Douglas,	9 30 15	Lyndon,	Osage,	10 27
Kinsley,	Edwards,	11 29 30	Osborne,	Osborne,	12 20
Ellsworth,	Ellsworth,	10 43	Minneapolis,	Ottawa,	11 22
Ottawa,	Franklin,	9 37 30	Phillipsburg,	Phillips,	11 55
Eureka,	Greenwood,	10 10 30	Louisville,	Pottawatomie,	10 57
Fordham,	Hodgeman,	11 45 30	Hutchinson,	Reno,	10 35
Burr Oak,	Jewell,	11 46	Survey,	Rooks,	11 50
Oswego,	Labette,	9 44 30	Lacrosse,	Rush,	11
Leavenworth,	Leavenworth,	9 46	Russell,	Russell,	11 4
Mound City,	Linn,	8 30	Salina,	Saline,	11 46 20
Peabody,	Marion,	9 8	St. John,	Stafford,	11 55
Marysville,	Marshall,	11 45	Washington,	Washington,	10 15
Paola,	Miami,	9 35	Fredonia,	Wilson,	10 30
Beloit,	Mitchell,	11 3	Yates Center,	Woodson,	10 30

The natural method of treating these observations is to mark on a map the declinations at the several places, interpolate to find points where the declinations are the same, and draw isogonic lines, *i. e.*, lines of equal declination. I have done this on a working map, and the results are far from satisfactory. On the supposition that the reports are all correct, the lines indicate—

1st, That the lines are comparatively regular in the extreme eastern part of the State, and in the western organized counties.

2d, That there is a large area of small declinations, containing the valley of the Kansas as far west as Ellsworth, and extending further from the river to the south than to the north. It contains the part of the Arkansas valley north of that river between Hutchinson and Great Bend, and the valley of the Republican. In Marion and Morris counties the declination is much smaller than in the rest of the area.

3d, The declinations in the valleys of the Saline and Solomon are greater than those in the neighboring portions of the Kansas valley, and correspond approximately to those in the western counties.

4th, The southern parts of the State are not included, as only the eastern counties of the southern rows have reported, and have already been included in the statement concerning the declination in the eastern part of the State.

These results are entirely different from any others of which I have any knowledge. The map showing "the lines of equal magnetic declination in the United States for the year 1875," published by J. E. Hilgard, Superintendent of the U. S. Coast Survey, indicates that the isogonic lines in Kansas run regularly, with an average direction of about N. 20° E., and other maps indicate the same. If, then, the reports of the county surveyors are correct, there is here an interesting field for investigation; but the reports are not numerous enough to allow any thorough discussion.

It seems to me, however, that we will get much nearer the truth by making a different supposition, viz.: that the reports are not all correct. Incorrect results can arise from many causes. The following seem to be the most likely to occur:

1st, Imperfect instruments. When a county surveyor uses a shaky instrument, or one whose needle is sluggish and unreliable, I know of no way to remedy the defect, other than by getting a good instrument. If constant errors are suspected, comparison with a good needle might do away with the difficulty.

2d, Carelessness. By carelessness, I do not mean hasty and poor work. Of such a charge each one should be considered innocent until proved guilty. But I do mean the neglecting to humor the needle, to let it swing freely in the box before coming to rest, and to protect it from accidental local attraction. An ax or chain inadvertently left near the instrument, or a pair of steel-rimmed spectacles worn during the observation, will sometimes cause errors amounting to two degrees.

3d, Defective meridian marks. This is probably the most frequent and troublesome cause of error. As a rule, county surveyors are not supposed to be adepts in astronomical operations, and the determination of a true meridian at any point is based on essentially astronomical observations. To do it well, the observer must not only have the knowledge, but must also be provided with suitable instruments—a good time-keeper, and a transit instrument so arranged that the cross-hairs can be made visible at night. A solar compass is a good instrument for the purpose, but is not generally considered as reliable as a portable astronomical transit.

I have no doubt that some way can be devised by which a competent person could be engaged to set up correct and permanent meridian marks at each county seat. At present, I do not know just how such an arrangement can be made. Until some such step is taken, these reports, required by law, and, if well taken, of great use to the landed interests of the State, and of value in the scientific discussion of magnetic phenomena, will remain of comparatively little importance.

BOTANICAL NOTES FROM THE SOUTHWEST.

BY B. B. SMYTH.

The studies herein contained were made in Barton and other counties of southwestern Kansas, along the line of the Santa Fé Railroad, from 1874 to 1880.

During the spring months, there is no place more beautiful or interesting to the passer-by or the botanist than the prairies of the southwest. The abundance, beauty and size of many of the flowers causes certain spots to rival some of the showy Eastern flower gardens. A study of these plants and flowers is not without attending difficulties. Very many of the plants are different from those growing east of the Mississippi, and are not described in the Botanies of Wood or Gray. A Synopsis of the Flora of Colorado, by Porter & Coulter, contains many plants of western Kansas; though there are still others of which descriptions are not readily attainable. I am under obligations to Prof. J. H. Carruth, of Lawrence, State Botanist, also to Prof. Wood, of New York, for the determination of many plants of which no description is at hand.

In March, there are two plants, besides a little carex three inches high, that open their blossoms, sometimes partly under the snow. One is a little wild parsnip, three inches high, with umbels of very small, white, fragrant flowers. It is said to be *Peucedanum nudicaule*, though the plant differs from the description in the following repects: the name *nudicaule* indicates a naked stem, while the plant is well covered with leaves half-way up the stem, and that

portion of the stem below the ground — three inches of it — is entirely sheathed with radical scales and leaves. Then the leaves, instead of being bipinnate or ternate-pinnate, are bipinnately or terpinnately divided — the segments pinnatifid or bipinnatifid. Occasionally the seeds are greatly inflated, becoming nearly half as thick as wide. An examination discloses a small, dark-colored coleopterous insect, seen nowhere else. In early seasons, the plant blossoms as early as February. The other is also a small umbelliferous plant, *Cymopterus montanus*, three inches high, blossoming toward the close of the month. It may be distinguished from the *Peucedanum* by its vernicose leaves, and its seeds with five or six vertical wings each, while the *Peucedanum* has but two.

Astragali are quite numerous and abundant; all blossom in April and May. Among the first is *Astragalus caryocarpus*, commonly called "buffalo pea." The blossoms vary on different plants, through all shades, from a pale straw-color to a rich crimson. They all change to yellowish in fading. The fruit is somewhat edible when young and tender. It is occasionally used as a substitute for green peas or asparagus. It is said by frontiersmen to possess powerful pectoral properties, clearing the throat and making the breath flow freer. The fruit, when ripe, resembles, in color, shape and size, a shell-bark hickory-nut, but is very light and corky.

A similar plant, blossoming at the same time, is *A. Mexicanus*. The color of blossom is about the same, with nearly the same variations. The habit and general appearance of plant and leaf are also much the same, and the plants are very apt to be confounded in the herbarium. An intimate acquaintance shows recognizable differences. In the latter, the stems, at the base, are smaller, harder and darker, and are more prone to cast root at the joints. The leaflets are a little more slender, and the pubescence, (what little there is,) is sparser and more closely appressed. But the fruit, when ripe, differs greatly. The pods are much smaller, harder, have a deeply sulcate ventral suture, and a hard, sharp, afflexed point.

Another astragalus that is quite showy is *A. mollissimus*. The flowers, a purplish straw color, are not showy, though the plant is quite so in the winter, with its large, green, very wooly leaves. I am informed by Prof. Popenoe that this is the "loto" plant, said to be poisonous to stock, though I believe they do not generally eat it.

A plant that is apt to be mistaken for an astragalus is *Oxytropis Lambertii*. It grows very abundantly on dry hillsides, each plant sending up numerous tall, loose racemes of crimson flowers. A hill covered with these looks like an immense floral mound.

There is a sort of dandelion (*Troximon cuspidatum*), with long, wavy-edged leaves. The flowers resemble the old-fashioned dandelion in many respects, and, like that, close in the evening and damp weather.

Abundantly, in some spots on the prairie, we find the wild onion (*Allium reticulatum*), with its pretty clusters of pink, star-shaped flowers, six inches

high. The flowers have the odor of, and much resemble, garden pinks, though care in handling is necessary, so as not to crush the plants, or the odor instantly changes. These have terete, hollow leaves. Later, a taller kind, twice the height, with white flowers and flat, carinate leaves, appears. These have not the pleasant pinky odor of the others; but the garlicky odor is stronger. There is a variety intermediate in height between these two, with white and pink striate petals, and semi-terete leaves, channeled on the upper side.

These flowers, gathered into a bouquet, are almost everlasting in form and color, and have an everlasting smell, too. There is a tall species, eighteen inches high, in moist places, that has bulbiferous umbels. These onions all have reticulated, fibrous bulbs. Cows are fond of the tops in spring, to the detriment of the butter. The bulbs form a large part of the food of the prairie squirrel. The low pink variety is worth cultivating, and would make a very pretty border in a flower garden early in spring.

On dry hills may be found abundance of *Sophora sericea*, a foot high, with its beautiful, whitish-green, silky, pinnate leaves, and terminal racemes of yellow pea-blossoms, and handsome, lead-colored calyxes.

In wet buffalo-wallows, and other wettish holes, there is a biennial species of evening primrose (*Œnothera triloba*), growing low to the earth, with many runcinate-pinnatisect leaves, about like those of a dandelion, and with rhomb-shaped yellow flowers, having a calyx tube three or four inches in length. When the seed is ripe and the leaves have fallen, the very short stem is entirely covered with the sessile, four-cornered capsules, as close as they can be crowded together. It much resembles, in size, shape and color, an old, overgrown pine cone.

A very showy species of trailing verbena is in blossom very early in May. It makes a pretty bed.

Early in May, the mallows all come into bloom. The scarlet mallow (*Malvastrum coccineum*) grows very abundantly nearly everywhere, on erect stems, ten inches high, and several to many blossoms open at the same time on each stem. These are really pretty flowers in a bouquet, and make a very pretty bed, when growing close together.

The crimson mallow (*Callirrhoe involucrata*) is one of the most showy flowers growing on the prairie. They are a bright crimson, with white centers, like a portulaca, and change to purple in drying. I have found them quite double. In certain spots they are to be found in great abundance, continuing to bloom all summer. The root is perennial, one to two or more inches in diameter, abounding in mucilage, and is eaten by Indians.

Another mallow (also a *Callirrhoe*) grows in damp places, on a weak stem eighteen inches high, and has white or pinkish petals, often fringed. The lower leaves are triangular, almost entire, a little above they are strongly crenate, and the upper leaves, still triangular in outline, are three to seven-parted, and the segments variously lobed and cleft.

Among dry rocks grows a very interesting little heath-like composite

(*Diplopappus ericoides*), three inches high, one of the earliest composites to bloom.

Poa compressa, a species of blue-grass, is found in abundance along water-courses.

Buchloe dactyloides, the famous buffalo grass of the plains, otherwise called curly or summer mesquite, is in full bloom by the middle of May. The staminate blossoms, with their orange anthers, are quite noticeable as they stand four or five inches high, but the pistillate blossoms are hidden under the grass, about one to two inches high, and must be sought attentively to be found, and may then be found in abundance. It is remarkable, the provision made for this grass to withstand drouth. I have traced the roots in a new well to a depth of full fifteen feet from the surface, reaching quite down to that stratum of earth seldom affected by summer heat.

Two species of pentstemon, twelve to eighteen inches, found in very dry sand-hills, both with very glaucous, waxy-looking, entire leaves, one with handsome, white or pinkish blossoms, the other with large, beautiful, blue blossoms. I have not succeeded in drying any of them without spoiling the color of the leaves.

Ceanothus Americanus, "red-root" or Jersey tea, is an abundant shrub in similar situations. If this plant was not a favorite in revolutionary times, its appearance deceives, for each of the petals, which rises on a little claw, tries to cover the pistil, and is shaped just like Israel Putnam's three-cornered hat of old.

About the middle of the month, the handsome spiderwort (*Tradescantia Virginica*) comes into bloom. It is abundant everywhere, and is one of the most noticeable flowers of the prairies. The flowers vary, through all shades of purple, from a very pale blue to a bright rose color. The extremes are not often found, and pure white ones are rarely found, though white ones with pink stamens sometimes appear. I have found them quite double. In one case a single flower had eight petals and sixteen stamens. They are, no doubt, capable of much improvement by cultivation.

On ground broken by gophers, and on new "breaking," we find the elegant little *Gaura coccinea*, ten or twelve inches high. Its flowers, when they first open, are white, soon change to rose color, and finally to scarlet before fading. It is one of the very few prairie flowers that is pleasantly fragrant.

About the 20th of May, on dry hillsides, I find plenty of *Pyrrhopappus grandiflorus*, (I know of no shorter name,) with brilliant yellow, dandelion-like flowers, two inches across, which are rendered more showy by contrast with the black anthers. The flower is single, on a solid, striate, one-bracted scape, rising from a radical stem, which in turn rises from a small, whitish, spongy tuber, three or four inches deep in the ground. I have never seen but one stem from one tuber; but frequently the stem is branched at or below the surface of the earth, and several scapes may arise in succession, each bearing one head. Frequently the stem may be destroyed, or even the top

of the tuber cut off, in which case the tuber throws up a new stem from an almost invisible eye. The leaves, which may be called radical, are mostly at the top of the subterranean stem, and are fewer, shorter, and not so deeply gashed as dandelion leaves. The juice is milky, like lettuce. The pappus is not fiery red, as might be supposed from the name, but a tawny white. The stem has two or three scales with dormant buds between the leaves and the tuber; the tuber has several almost invisible eyes.

Other flowers blooming at the same time are *Baptisia australis*, with its coarse-looking blue flowers, nearly always gnawed by insects; *Œnothera serrulata*, a half-shrubby species, with large, crumpled petals; *Psoralea argophylla* and *floribunda*; *P. cuspidata*, with a large inflated calyx; *Aplopappus spinulosus*; *Asclepias speciosa*; *Glycyrrhiza lepidota*; *Schrankia uncinata*, the wonderful and very fragrant sensitive brier; and many others equally interesting. Yarrow is common.

A feature in this western country is the very showy and really splendid evening primrose (*Œnothera grandiflora*). It opens at a time of day when most other flowers are closed for the night, and next morning has lost its brilliant color; otherwise it would be admirable. Spots that in the spring were all pink and blue and white with anemones and wild onions, in May are purple all day with spiderworts, and yellow all night with evening primroses.

Nearly everywhere on dry prairie, and very abundant on barren prairies, in northern Barton and Rush, grows the smokeweed (*Plantago gnaphaloides*), with spikes eight inches high, of minute white flowers. Growing alone on barren hillsides, it gives the land a bluish-gray or smoky appearance; and further north and west, where it grows more abundantly, it is said to have been the cause of the name of the Smoky Hill.

Toward the close of the month the pincushion cactus (*Mamillaria cæspitosa*) opens its blossoms. The petals vary from straw color to amber. The stigmas are green. Likewise the red pincushion cactus (*M. vivipara*) may be found in bloom. The petals vary from a pale pink to a bright red. The stigmas are red, pink, or pure white—never green. The plant, when not in blossom, may easily be distinguished from the yellow cactus, by its having several divergent brown spines at the end of the tubercles, in addition to the circle of white spines. The fruit, too, is green when ripe, while that of the straw-colored species is red. Otherwise they are much alike.

A charming little bloomer in dry situations is *Polygala alba*, ten inches high, in dense tufts of slender stems, covered with small, white, oddly-shaped flowers, that last till the seed is half ripe.

On dry, barren rocks and bluffs may be seen in its luxuriance *Yucca angustifolia*, otherwise called "soap-root," "Spanish dagger," etc. Its numerous long, narrow, evergreen leaves are charming in the winter when everything else has turned brown. They are frequently used by hunters as cords to hang up meat. The roots are large and very long. They are believed to have burst rocks asunder by constant growing pressure.

And now we come to the crowning glory of the season—the prairie rose. Other flowers may be more brilliant, others more fragrant, others more interesting; but there is no flower that combines the beauty, the fragrance, the sweetness, the homelikeness of the rose, or anything to equal it.

Many of the flowers of May are worthy of cultivation. As best adapted to this purpose, I would recommend the scarlet and crimson mallows, the pentstemons, the spiderwort, the little gaura, the pyrrhopappus, the showy evening primrose, the shrubby evening primrose, the round cactuses, the yucca, and the rose. They will all bear cultivation, and will amply repay any pains bestowed upon them.

Early in June, in sandy spots, may be found in abundance the very interesting day-flower (*Commelyna angustifolia*), growing on low, grass-like plants, with beautiful deep-blue flowers, with two petals only, the third being suppressed, having a mere rudiment just visible. Curiously enough, the three stamens opposite the perfect petals are barren, and furnished with yellow cruciform glands instead of anthers, while the three stamens opposite the abortive petal are fully developed, and have large purple anthers. The long style bends down to meet the purple stamens. The flowers are very delicate and short-lived.

The wild gourd (*Cucurbita perennis*) is frequently found. The root is a large inverted cone, sometimes eight to twelve inches, or more, across, and throwing out numerous vines each year from the margin of the crown. The leaves are large, rough, cordately triangular, lamina carinate, rising from the vine right and left alternately, and pointing outward. The fruit is globose, one at each leaf nearly, about the size of an orange, and striped yellow and green. It is intensely bitter.

In Stafford county, in barren alkaline lands among the sand-hills, may be found abundance of *Portulaca pilosa*, resembling in every respect the portulaca of our gardens, except that the rose-colored flowers are quite small.

In similar lands may be found a very rough, small, brittle species of Opuntia, with very wicked spines. These plants almost cover the ground in spots, and are a terror to horses. The joints when touched break off, and cling like a burr, and when stepped on, the spines penetrate a horse's hoof or a man's boot. I have not seen them in bloom.

The blossoms of the ordinary prickly pear (*O. vulgaris*) have very sensitive and irritable stamens. When touched, they spring suddenly against the pistil.

A morning glory (*Ipomea leptophylla*), with red blossoms four inches deep and three broad, is frequent. The plant has a large fusiform root, four to six inches thick and very tough, so that a plow cannot penetrate it.

The thistle poppy (*Argemone Mexicana*), with its large white flowers, four inches across, and yellow stamens, is very noticeable.

On dry prairies may be seen a species of wild four-o'clock (*Oxybaphus angustifolius*), tall and slender, with very narrow leaves and pretty pink

flowers. These flowers open about two hours before sunset, and roll up close early next morning.

A certain tribe of Leguminosæ, including the *Psoralea, Amorpha, Dalea, Petalostemon*, etc., is well represented here. Common peculiarities of these plants are, that they have yellow, thick-barked, strong-scented roots, glandular or dotted leaves, and more or less imperfect flowers. Most of them bloom in midsummer. I have already mentioned Astragalus and Psoralea, which bloom earlier.

Of Amorpha there are two species (*A. fruticosa* and *A. canescens*), both common. Both have handsome little terminal spikes of sweet-scented blue flowers, the former very dark-blue, the latter sky-blue. There is only one petal—the banner—which enwraps the blossom like a cloak. The latter, which is commonly called "shoe-string," or "devil's shoe-string," is remarkable for its long, tough, slender roots. I have traced a root, not exceeding half an inch thick at the surface, straight down to a depth of twenty-six feet. Several divisions of the root, before reaching that depth, reduced the thickness to veritable strings.

Petalostemons are frequent. There are three species (*P. violaceus, candidus*, and *villosus*). The peculiarity of these flowers is that there are no petals proper, but five alternating stamens are converted into petals, four of them oblong, and the fifth one, that takes the place of the tenth stamen, cordate. They are all raised on claws.

There are three species of *Dalea*, namely, *laxiflora, alopecuroides*, and *aurea*. *Dalea laxiflora* has a peculiarity of its own. It has but nine stamens, the tenth one being converted, as in the Petalostemons, into a cordate banner. It would thus seem to form a link connecting these two genera. This plant is otherwise interesting in its beautifully plumose calyxes. The spike is slender and loose—the flowers arranged in three ranks that run a little spirally up the stem.

Hosackia Purshiana is very common. There are two strongly-marked varieties of this species. The first is small, say six inches high, slightly branched, grows abundantly on uplands, blossoms in June, ripens in July and August, and is much eaten by sheep. The second is eighteen to twenty-four inches high, very branched, grows mainly in bottom lands, and sparsely in uplands, blossoms in July and August, and ripens in September. An important peculiarity of this variety is, that when standing alone and in nowise crowded, it throws its branches invariably north and south alternating, and its branchlets crosswise. Before the branchlets appear, the leaves face east in the morning and west in the evening. At such times the plant has a very flat appearance, being often two feet high and the same in breadth. After the branchlets grow, and the blossoms are open, that flat appearance is lost, the leaves face up, and the plant becomes a little more irregular, though the north-and-south direction of the branches is never wholly lost. The plant commences branching at about six inches high, and from that up, bears in

each axil either a branch, a branchlet, or a flower. I have counted on a very large specimen upward of 300 little pods, nearly all ripe, one inch in length, and each containing about five little, hard, dark, speckled beans. That plant was nearly three feet high, and about two and a half across, north and south.

In July and August blooms, in alkaline lands, near Great Bend, a gentian-like plant, Eustoma Russelliana, with very entire, whitish, glaucous, waxy-looking leaves, and beautiful, large, purple, violet, bluish, pinkish, or white flowers. Like the penstemons, they turn dark in the press.

Around the edges of such lands grows a species of composite, *Flaveria linearis*. This plant is three feet high, very branched, grows rank, has angular, red, green, or striped stems, opposite leaves, and a strong smell, nearly like fire-weed. There might be on a branch 30 to 80 very small, triangular heads, packed into a dense corymb, each head having a small, yellow ray, the rays all pointing outward from a common center. Each head has, in addition to its one ray, three or four disk-flowers, that bear very small, black seeds.

I have found Liatris squarrosa, with very white flowers, instead of red.

I append a floral clock for the months of July and August:

FLORAL CLOCK.

3 A. M.—Calystegia Sepium, (withers about 10 A. M.)

4 A. M.—Ipomea leptophylla, (withers at noon.)

5 A. M.—Evolvulus argenteus, (closes at 4 P. M.)

6 A. M.—Pyrrhopappus grandiflorus, (closes at 6 P. M., to reopen next day. Closes also in rain or dense clouds.)

7 A. M.—Callirrhoe involucrata, (closes at 6 to 7 P. M., to reopen next day.)

8 A. M.—Linum rigidum, (falls off at 4 P. M.)

8 to 9 A. M.—Specularia leptocarpa.

9 A. M.—Portulaca pilosa, (closes at 1 P. M.; does not reopen.)

9 to 10 A. M.—Portulaca oleracea, (native.)

11 A. M.—Talinum teretifolium.

12 M.—Hibiscus Trionum, (naturalized.)

2 P. M.—Mamillaria vivipara, (closes at 5 P. M., to reopen next day.)

4 to 5 P. M.—Oxybaphus nyctagineus, (closes next morning) Oxybaphus angustifolius, (closes at 5 A. M. next day.)

6 to 7 P. M.—Œnothera sinuata, (wilts next day.)

7 P. M.—Œnothera grandiflora, (opens very promptly; wilts at 7 A. M. next day.)

This clock is subject to more or less correction and regulation.

I append also a floral calendar up to July, but the list, though useful for reference, is too long to read.

Not having perfected the list beyond July, I omit it.

FLORAL CALENDAR.

MARCH.

15th.—Peucedanum nudicaule (?)

25th.—Cymopterus montanus.

APRIL.

4th.—Astragalus caryocarpus, elm.

8th.—Anemone Caroliniana, flowering currant.

10th.—Viola cucullata, wild plum.

12th.—Astragalus Mexicanus, soft maple.

13th.—Cercis Canadensis, box elder.

15th.—Troximon cuspidatum, wild gooseberry.

16th.—Draba Caroliniana.

18th.—Lithospermum longiflorum, choke cherry, Myosurus minimus.

20th.—Allium reticulatum, Baptisia leucophæa.

22d.—Oxalis violacea.

25th.—Senecio aurea.

27th.—Lathyrus linearis.

28th.—Œnothera triloba.

30th.—Sophora sericea, Verbena Aubletia.

MAY.

1st.—Astragalus Missouriensis, Callirrhoe digitata.

2d.—Oxalis stricta, Poa compressa.

3d.—Astragalus lotiflorus, Callirrhoe involucrata.

4th.—Allium reticulatum alba, Buchloe dactyloides, Smilacina stellata.

5th.—Ceanothus Americanus, Vitis riparia.

6th.—Rhus radicans, Diplopappus ericoides, Polygala alba, Linum (perenne?—a perennial,) Pentstemon (albidus?)

7th.—Malvastrum coccineum, Lithospermum canescens, Actinella scaposa, Oxytropis Lambertii.

8th.—Gaura coccinea.

9th.—Onosmodium Virginicum.

10th.—Hymenopappus scabiosæus, Physalis Pennsylvanica.

11th.—Œnothera serrulata, Ampelopsis quinquefolia.

12th.—Acerates viridis, Baptisia leucantha.

13th.—Delphinium tricorne, Achillea millefolia, Tradescantia Virginica, Poa compressa.

14th.—Pentstemon (cyananthus?) Asclepias —— (melliferous), Lippia cuneifolia (lanceolata?) Acerates paniculata.

15th.—Pyrrhopappus grandiflorus, Calystegia Sepium, Psoralea argophylla.

16th.—Amorpha fruticosa, Psoralea floribunda, Evolvulus argenteus.

17th.—Linum rigidum, Gymnocladus Canadensis, Achillea millefolia, Psoralea hypogea.

18th.—Teucrium Canadense, Yucca angustifolia.

19th —Aplopappus spinulosus, Verbena bracteosa.

20th.—Oxybaphus angustifolius, Diplopappus ericoides.

21st.—Houstonia tenuifolia.

22d.—Asclepias speciosa, Glycyrrhiza lepidota.

23d.—Œnothera sinuata, Mamillaria vivipara.

24th.—Œnothera grandiflora, Brizopyrum spicatum.

25th.—Schrankia uncinata, Apocynum hypericifolia, Mamillaria cæspitosa.

26th.—Symphoricarpus racemosus, Cornus paniculata.

27th.—Rosa blanda, Thelesperma gracile.

28th.—Plantago gnaphaloides, Lepachis columnaris.

29th.—Monarda punctata, Helianthus rigidus, Apocynum androsæmifolium.

30th.—Solanum rostratum, Hordeum jubatum.

31st.—Asclepias tuberosa aurea, Acerates longifolia, Helianthus rigidus.

JUNE.

1st.—Sisyrinchium anceps, Erigeron strigosum.

2d.—Stipa juncea.

3d.—Hosackia Purshiana.

4th.—Ipomea leptophylla, Talinum teretifolium.

5th.—Commelyna angustifolia.

6th.—Cornus circinata, Kœleria cristata.

7th.—Onosmodium Virginianum.

8th.—Lithospernum canescens.

9th.—Oxybaphus nyctagineus, Opuntia vulgaris.

10th.—Portulaca pilosa, Cucurbita perennis.

11th.—Argemone Mexicana, Lythrum alatum.

12th.—Specularia leptocarpa, Specularia perfoliata.

13th.—Acerates lancifolia, Amorpha canescens.

14th.—Solanum rostratum.

15th.—Verbena stricta, Rhus glabra, Salvia lanceolata.

16th.—Martynia proboscidea, Lygodesmia juncea.

17th.—Gaura biennis.

18th.—Ruellia ciliosa.

19th.—Petalostemon violaceum.

20th.—Sambucus Canadensis.

21st.—Croton Texensis, Frœlichia floridana.

22d.—Polygala alba, Sida spinosa.

24th.—Petalostemon candidum.

25th.—Cleome integrifolia.

26th.—Polanisia uniglandulosa.

27th.—Acerates angustifolia, Cirsium undulatum, Coreopsis tinctoria.
28th.—Asclepias tuberosa, Rhus radicans.
29th.—Dalea aurea, Dalea alopecuroides.

JULY.

Petalostemon villosus, Cenchrus tribuloides, Mentzelia albicaulis, Cuscuta chlorocarpa, Desmanthus brachylobus, Stenosiphon virgatus, Gerardia purpurea, Cleomella angustifolia, Lobelia cardinalis, Salvia Pitcheri, Asclepias verticillata, Silphium laciniatum, Asclepias incarnata, Vernonia fasciculata, Liatris pychnostachya, Cassia chamæcrista, Frœlichia procumbens, Acerates rotundifolia, Asclepias verticillata nana, Polygonum persicaria, Cuscuta glomerata, Erigeron divaricatum, Paronychia Jamesii, Gaillardia pulchella, Grindelia squarrosa, Eustoma Russelliana, Flaveria linearis, Liatris squarrosa, Euphorbia marginata, Cassia Marylandica, Phaseolus diversifolius.

STONE IMPLEMENTS IN TREGO COUNTY.

BY J. SAVAGE, LAWRENCE.

In company with Prof. Patrick, of the State University, the writer made a short collecting tour in Trego county, Kansas, in 1878. We stopped off at the new town of Wa-Keeney, for headquarters, and made side-trips to different parts of the county

The third day after our arrival, we made an excursion nine miles northwest of Wa-Keeney, on the Saline fork of the Kansas river, to look after some bones reported to be of large size. We found them to be the bones of a buffalo, and protruding from the alluvial soil upon the side of a draw or ravine.

It was here, at the residence of Mr. J. M. Davis, that we found numerous fragments of stone implements lying about the premises. These we readily secured through the generosity of Mr. Davis, and also made arrangements for saving any others he might afterward find. The implements thus secured, whole and in fragments, amount to several hundred pounds in weight. They consisted of stone mallets (many of them of large size), pestles, lap-stones, grinding-stones, and smoothing-stones. The smoothing-stones were many of them much worn by use, and nearly all of them were unbroken.

The bottom upon the north bank of the Saline, where most of these implements were found, was covered so thickly with tent-poles, of oak and cedar, that Mr. Davis and some of his neighbors used them for firewood nearly all summer; and what seemed to me a little singular was, that over several acres of the bottom and slope adjoining were, mixed with the coarse sand of the numerous ant-hills, many glass beads of various colors, and of recent

origin. So plentiful were they, that one could find several beads in almost every little heap of sand, or rather fine gravel.

Near by this locality a stone hatchet was found, with a handle of wood already attached to it. This hatchet I was unable to see or secure, as it was mislaid or lost in removing from a dug-out to a log house. I also learned from several neighbors living near this locality, that the best and choicest hammers and other implements had been, previous to our visit, gathered up and sent away to relic-loving friends living in different localities East, thus leaving only the greatest part of the cast-away ones for our hands to gather up.

The hammers were all made of metamorphic rocks, such as quartz, quartzite, granite and scienite—rocks which are not found in any part of Kansas that we are aware of. The smoothing-stones may, or may not, have been natives of our State. The tent-poles, those that I saw, were much worn upon their tip-ends, by being dragged over long distances upon the rough ground.

LIST OF LEPIDOPTERA,

COLLECTED NEAR IDAHO SPRINGS, COLORADO, BY THE KANSAS UNIVERSITY SCIENTIFIC EXPEDITION FOR 1879.

BY PROF. F. H. SNOW, OF THE UNIVERSITY OF KANSAS.

The following species of *Lepidoptera* were taken from July 26, to Sept. 8, 1879, by the writer, assisted by two scientific students of the Kansas University—Mr. Louis L. Dyche and Miss Annie E. Mozley. No little aid was also rendered by my son Willie, ten years of age, whose quick eyes discovered several species not observed by older members of the party. Our camp was located in the Chicago creek cañon, within one mile of Idaho Springs, and at an estimated altitude of 7,600 feet above the sea. The *Noctuidæ* were nearly all taken "at sugar," and the list in this family is chiefly remarkable for the large number (40) of species of the genus *Agrotis*, many of which were new to science, and have been described by Prof. A. R. Grote, chiefly in the "North American Entomologist." A very interesting "find" was a single perfect specimen of *Catocala relicta*, which is, I think, the first capture of that "queenly" species in the Rocky-Mountain region. One new *Catocala* was also taken—*C. pura* Hulst. It is quite likely, however, that this may prove to be *C. Semirelicta* Grote, as was first suggested by Mr. Herman Strecker. This suggestion was made prior to the description of the species by Mr. Hulst, from specimens of my own capture, received by him from Mr. Strecker. The list includes a few species taken during a brief expedition to Gray's Peak, the locality being especially men-

tioned in every such case. Among these was a new *Chrysophanus*, taken at the foot of the precipitous ice-mass between Gray's Peak and Irwin's Peak, down which a perilous descent had just been made. A description of this new diurnal, by Wm. H. Edwards, will be found at the end of the list. The new *Halesidota* was given to me by my young friend Geo. I. Cannon, of Idaho Springs, who captured it at Boulder, Col. Prof. Grote has furnished descriptions of two of the new species of *Noctuidæ*, for publication in connection with this list. These are *Gortyna juvenilis* and *Hadena discors*. To these new descriptions is added a reprint of descriptions of all other new species obtained by the expedition. Acknowledgments are hereby made to Messrs. Grote, Edwards, and Packard, for valuable favors in determining unknown species.

LEPIDOPTERA RHOPALOCERA.

Papilio Daunus *Edw.*
Parnassius Smintheus *Doubl.*
Pieris Menapia *Feld.*
Pieris Protodice *Bdl.-Lec.*
Pieris occidentalis *Reak.*
Pieris Napi, var. pallida *Scud.*
Nathalis Iole *Bdl.*
Colias Eurytheme *Bdl.*
Colias Keewaydin *Edw.*
Colias Meadii *Edw.* Gray's Peak.
Colias Alexandra *Edw.*
Colias Philodice *Godt.* var.
Colias Scudderii *Reak.*
Terias Mexicana *Bdl.*
Danais Archippus *Fab.*
Danais Berenice *Cram.* Gray's Peak.
Euptoieta Claudia *Cram.*
Argynnis Alcestis *Edw.*
Argynnis Eurynome *Edw.*
Argynnis Helena *Edw.*
Argynnis Edwardsii *Reak.*
Melitæa minuta *Edw.*
Phyciodes Camillus *Edw.*
Grapta Satyrus *Edw.*
Grapta Zephyrus *Edw.*
Vanessa Antiopa *Linn.*
Vanessa Milbertii *Godt.*
Pyrameis cardui *Linn.*
Pyrameis Atalanta *Linn.*
Limenitis Weidemeyerii *Edw.*
Satyrus Charon *Edw.*
Erebia Callias *Edw.* Gray's Peak.
Erebia Epipsodea *Butl.* Gray's Peak.
Thecla humuli *Harr.*
Thecla sæpium *Bdl.*
Thecla mopsus *Hub.*
Lemonias Nais *Edw.*
Chrysophanus Virginiensis *Edw.*
Chrysophanus Sirius *Edw.*
Chrysophanus Snowi *Edw.* n. sp. Gray's Peak.
See description in article following this list.
Chrysophanus helloides *Bdl.*
Lycæna Sæpiolus *Bdl.* Gray's Peak.
Lycæna orbitulus *Von Prunner.* Gray's Peak.
Lycæna Melissa *Edw.*
Lycæna Isola *Reak.*
Eudamus Tityrus *Fab.*
Pamphila comma *Linn.*
Pamphila Uncas *Edw.*
Pamphila Agricola *Boisd.*
Pyrgus tessellata *Scud.*
Pyrgus centaureæ *Rambr.*
Nisoniades Persius *Scud.*
Pholisora catullus *Cram.*

LEPIDOPTERA HETEROCERA.

Deilephila lineata *Fab.*
Gnophæla vermiculata *Grote.*
Anatolmis Grotei *Packard.*
Lycomorpha miniata *Packard.*
Lithosia bicolor *Grote.*
Halesdota trigona *Grote* n. sp.
Crocota sp.
Acronycta Theodori *Grote.*
Agrotis baja *S. V.*
" rufipectus *Morr.*
" sexatilis *Grote.*
" tessellata *Harr.*
" decolor *Morr.*
" redimicula *Morr.*
" Ridingsiana *Morr.*
" 4—dentata *G.* and *R.*
" gagates *Grote* (= mimallonis *Grote.*)
" chortalis *Harvey.*
Agrotis aratrix *Harvey.*
" fumalis *Grote.*
" messoria *Harr.*
" pastoralis *Grote.*
" malefida *Guen.*
" telifera *Harr.*
" inconcinna *Harvey.*
" brocha *Morr.*
" turris *Grote.*
" albipennis *Grote.*
" pyrophiloides *Harvey.*
" sierræ *Harvey.*
" variata *Grote.*
" basalis *Grote* n. sp.
" munis *Grote* n. sp.
" mirabilis *Grote* n. sp.
" conchis *Grote* n. sp.
" olivalis *Grote* n. sp.

Agrotis parentalis *Grote* n. sp.
" cænis *Grote* n. sp.
" catenula *Grote* n. sp.
" decipiens *Grote* n. sp.
" minimalis *Grote* n. sp.
" vocalis *Grote*.
" atrifera *Grote*.
" placida *Grote*.
" vernilis *Grote*.
" verticalis *Grote* n. sp.
" docilis *Grote* n. sp.
" (Eurois) occulta *Hubn*.
Mamestra adjuncta *Guen*.
" Farnhami *Grote*.
" lilacina *Harvey*.
" trifolii *Esp*.
" olivacea *Morr*.
" acutipennis *Grote*.
" discalis *Grote*.
Hadena devastatrix *Grote*.
" lateritia *var*. dubitans *Walk*.
" auranticolor *Grote*.
" longula *Grote*.
" genetrix *Grote*.
" flavidens *Grote*.
" discors *Grote* n. sp.
Hyppa xylinoides *Guen*.
Oncocnemis Chandleri *Grote*.
Oncocnemis Glennyi *Grote*.
Oncocnemis homogena *Grote*.
Polia illepida *Grote*.
Laphygma frugiperda *Guen*.
Eupsephopœctes procinctus *Grote*.
Nephelodes minians *Guen*.
Gortyna juvenilis *Grote* n. sp.
Leucania Harveyi *Grote*.
Leucania (near) adjuta *Grote*.
Leucania (near) phragmitidicola *Guen*.
Leucania unipuncta *Haworth*.
Caradrina bilunata *Grote*.
Caradrina undet. species.
Orthosia Conradi *Grote*.
Orthosia n. sp. not described.
Scoliopteryx libatrix *Linn*.
Plusia Hochenwarthi *Hoch*. Gray's Peak.
Plusia Sackenii *Grote*.
Plusia u-aureum *Boisd*.
Anarta melanopa *Thunb*. Gray's Peak.
Anarta nivaria *Grote*. Gray's Peak.
Euleucyptera cumatilis *Grote*.
Lygranthœcia brevis *Grote*.
Melicleptria villosa *Grote*.
Heliothis armiger *Hubn*.
Heliothis nuchalis *Grote*.
Pyrrhia stilla *Grote* n. sp.
Drasteria erechtea *Hub*.
Melipotis pallescens *G.* and *R*.
Catocala relicta *Walk*.
Catocala pura *Hulst*. n. sp. (= semirelicta?)
Catocala briseis var. Grotiana *Bailey*.
Catocala briseis var. Hermia *Hy. Edw*.
Catocala aspasia *Streck*. (= Walshii?)
Catocala perdita *Hy. Edw*.
Homophyralis n. sp. not described.
Hypena humuli *Harr*.
Eupithecia miserulata *Grote*.
Glaucopteryx cæsiata *Borkh*.
Glaucopteryx magnoliata *Guen*.
Petrophora prunata *Linn*.
Petrophora (near) nubilata *Pack*.
Ochyria munitaria *Hubn*.
Ochyria lignicolorata *Pack*.
Thamnonoma tripunctaria *Pack*.
Thamnonoma subcessaria *Pack*.
Thamnonoma flavicaria *Pack*.
Phasiane trifasciata *Pack*.
Semiothisa granitata (?) *Guen*.
Aplodes rubrifrontaria *Pack*.
Cymatophora humaria *Guen*.
Gnophos Haydenata *Pack*.
Cleora umbrosaria *Pack*.
Opisthograptis sulphuraria *Pack*.
Sicya macularia *Harr*.
Therina fervidaria *Hubn*.
Azelina Hubneraria *Guen*.
Tetracis Colorodaria *Pack*.
Nomophila noctuella *S. V*.
Botis socialis *Grote*.
Eurycreon sticticalis *Linn*.
Eurycreon cerealis *Zeller*.
Pterophorus undet. species. Gray's Peak.

Number of species: Rhopalocera, 53; Heterocera, 127; total, 180 species.

NEW WESTERN NOCTUIDÆ.

BY A. R. GROTE, NEW YORK.

The forms noticed in this paper were collected by Prof. F. H. Snow, at Idaho Springs, Colorado. The first two descriptions are here published for the first time; the remainder appeared in the North American Entomologist, November and December, 1879, except *Catocala pura* and *Agrotis verticalis*, which were published in the Bulletin of the Brooklyn Entomological Society, April and August, 1880.

HADENA DISCORS n. sp.

The hind wings are white, with black, distinct, incompletely-broken terminal line, fringes faintly interlined, uneven, veins and terminal space slightly dusted with fuscous. The eyes are naked, abdomen tufted at base and thorax on the dorsum; the antennæ are pyramidal, ciliate. Anterior wings reddish-brown and blackish, slightly dusted with ochery scales. The style of ornamentation recalls *castanea* or the *grandis* group of *Mamestra*. A narrow black basal dash, and one below it on internal margin. Lines double, black, indistinct. Anterior line upright, thrice dentate, its outer component line marked with black and more distinct. Median space stained with reddish brown. Claviform moderate, acute, lined in black and connected by a black dash with posterior line. Orbicular speckled with ochery, rounded, slightly oblique, rather large. Reniform resembling orbicular in color, with faint interior annulus, upright, extending below median vein, which also shows scattered ochery scales. Posterior line dentate opposite the cell, badly defined superiorly, marked in black on its inner component line on submedian space opposite the claviform. Subterminal marked by three pale interspacial flecks between veins two and five, a black streak opposite the cell and one below vein two. Terminal space narrow, blackish, fringes dusky brown, finely cut with pale. Thorax with a fine line or collar, tegulæ lined with black. Beneath whitish, with distinct black discal marks. The dentate fringes brownish, before them a black interrupted line. The wings show reddish stains. The abdomen is fuscous above, laterally and beneath, reddish or purplish. *Expanse* 40 mil.

GORTYNA JUVENILIS n. sp.

Eyes naked, front smooth, tibiæ unarmed, middle pair with rather long scales covering the joint; form slender, wings rather long and narrow, apices acute. Light yellow, ornamentation rather like *sera*, lines and spots present. All three stigmata concolorous, subequal, claviform smallest, orbicular round, reniform obovate, narrowing inferiorly, where it is touched with white. The linear angulate brown median shade is continuous between the discal spots. In the female the median space is shaded with dusky. Lines single, outer line scalloped on the interspaces. Terminal space darker than the rest of the wing, divided by the fuscous s. t. line which hardly reaches the apices, seeming to reach external margin at vein seven; fringes and external margin reddish fuscous. Hind wings dark fuscous, very dark and contrasting in the female, fringes reddish fuscous. Body yellowish, concolorous with fore wings. Male antennæ shortly ciliate, female simple. Beneath both wings yellowish, shaded with reddish fuscous, with faint common exterior line. This species is recognizable from its slender make, the contrast of the fuscous secondaries with their under surface and with the primaries. *Expanse* 28 to 29 mil.

HALESIDOTA TRIGONA n. sp.

By its almost vermilion-red abdomen above, allied to the Californian *Edwardsii*. Fore wings blackish or dark lead color, with scattered red and dark

scales, and a lilac tint about internal angle. A large, irregularly-triangular pellucid costal patch beyond the cell, its base along the costa, which is here yellowish, but narrowly crimson at the base. This patch is bordered with yellow, and shows scattering dots of dark scales. There are two small, rounded yellow spots, one within and below the other, on internal margin at basal third. A red and yellow terminal line at base of fringes, which are dark, interrupted with yellow at end of veins. Hind wings white, washed with bright red. Abdomen, above bright red, below white. Legs white, with the front pair bright red within on femora, and with dusky tibiæ and tarsi. Fore wings beneath largely red; the transparent patch shaded with yellow, and without dots. Head and thorax lead color; latter shaded with red and yellow, beneath white. *Expanse* 45 mil.

To the preceding description, as published in the North American Entomologist, Mr. Grote adds the following: "Closely resembles the Brazilian *specularis*, H.—S., Exot. Fig. 59. It differs by the smaller size of the vitreous spot, the outer edge of which is farther from the external margin, and more even — less scalloped. The Brazilian species wants the yellow terminal shade-line. There is a great resemblance between the two widely geographically separated forms."

AGROTIS MIRABILIS n. sp.

Fore tibiæ unarmed; male antennæ simple. Blackish fuscous; terminal space paler, powdered with grayish. Lines obliterate. Median lines approximate. Subterminal defined by difference of shade. Discal spots contrasting, yellowish or ochery white in a black shade; orbicular reduced, reniform moderate, subquadrate. A whitish dot in front at insertions of fore wings. Head collar and tegulæ concolorous; dorsum of thorax pale reddish, contrasting; tegulæ with indistinct inner black edging. Hind wings dark fuscous, with pale interlined fringes. Beneath dark fuscous powdered with grayish; on primaries the inception of common line marked in black, and costal dots. *Expanse* 36 mil. Allied to *discoidalis*, but very different in color.

AGROTIS BASALIS n. sp.

All the tibiæ spinose. Male antennæ brush-like. By its brown-red color allied to *gagates;* but the basal space is shaded with grayish clay color. Lines double, marked by dots on costa. Terminal space dull blackish, contrasting with the rest of the wing. Subterminal line powdery, pale. Stigmata prominent, discolorous, grayish, with black annuli margined within by a whitish ring. Orbicular well sixed spherical; reniform upright, curved, of the usual shape. Fringes fuscous. Hind wings smoky fuscous, with pale, interlined fringes; paler in the male. Abdomen reddish beneath. Head and thorax brownish red. Wings beneath with obliterate markings; costa powdered with red. Three specimens. *Expanse* 40 mil.

AGROTIS MUNIS n. sp.

All the tibiæ armed; male antennæ brush-like. Of a peculiar lilac gray, rather pale, with distinct ornamentation, recalling *euroides*. Lines single, black, well written, dentate. Stigmata concolorous; claviform sharp, outlined in blackish. Reniform and orbicular large, vague; cell black between them. Subterminal line broken into shade marks, better marked on costa. Median shade marked below the reniform. Hind wings pale fuscous, with concolorous fringes and discal mark. In the male paler, allowing double extra-mesial shade lines to be visible. Beneath with discal lunules and extra-mesial subdentate common shade line. Palpi dark at the sides. Resembles *Fernaldi*, but the lines are narrower, the subterminal line is broken into blackish patches, the extra-mesial line is not angulate on the secondaries. *Expanse* 35 to 40 mil.

AGROTIS CONCHIS n. sp.

All the tibiæ spinose. Allied to *C. nigrum;* recalls *Hilliana* by the brightness of the ocher stigmata. Fore wings light lilac gray, smooth, with a blackish tone. Base ocher, bounded by the half-line. Orbicular light ocher, open to costa, outwardly oblique. Reniform upright, wide at base, with a deep ocher interior ring. Median lines wide apart. Exterior line evenly scalloped, followed by points. Subterminal space darker, with blackish costal shade. Subterminal line followed by a pale shade line. Terminal space like s. t., gray at apices. Disk between and about the stigmata clouded with rich blackish brown. Claviform indicated. Median shade apparent below reniform. Head and collar bright ocher; tegulæ brownish ocher; dorsum very pale dusty ocher. Hind wings with a pale ochery ground, shaded with fuscous. Beneath, pale, with common continued scalloped line and discal lunules open on primaries. Abdomen light brownish ocher; breast light brownish; palpi dark brown at sides. *Expanse* 40 mil.

AGROTIS OLIVALIS n. sp.

All the tibæ spinose. Allied to *ridingsii*. Dark olive with clear bluish white stripes and markings. Collar with a mesial dark line. Thorax in front crossed by a black line followed by a white band. Costa shaded with white; median vein narrowly striped with white. Transverse posterior line followed by white shadings, spreading from the veins, crossing the s. t. line below apices, at the median nervules again, and at internal margin; these white shades are alternated with black cuneate marks. Orbicular narrow, oblique, white, with narrow dark center, filled in with white next the annulus; claviform concolorous, long, black-edged. A black, even terminal line. Hind wings fuscous with whitish, interlined fringes. Beneath with double extra-mesial diffused shade lines and faint discal marks. Thorax dark olive; abdomen fuscous. *Expanse* 32 mil.

AGROTIS PARENTALIS n. sp.

All the tibiæ spinose; antennæ simple, ciliate beneath. Allied to *decipiens*, but quite different in color. Lines deep black. General color gray,

suffused with reddish-brown. Median space darker. Basal half-line deep black. Median lines, dentate and excavate, deep black, approximate. Costal region diffusely gray shaded. Claviform moderate, deep black. Orbicular concolorous, large, rounded. Reniform subequal, upright, subquadrate; disk blackish. Exterior line, moderately produced and excavate, marked by vein points. Subterminal line faint, vague, broken. A fine slightly uneven terminal black line. Fringes concolorous. Hind wings pale fuscous, with reddish fringes concolorous with those on primaries. Thorax concolorous, with mesial ridge, without markings except a faint line on collar. Beneath pale, tinged with reddish, with traces of a common line. *Expanse* 38 mil.

AGROTIS CAENIS n. sp.

Allied to *lubricans*, but without any line on the collar; the t. p. line more inwardly oblique. Dark gray, shaded and splashed with red. Markings all indistinct and the lines broken. Orbicular round, moderate, gray, with darker center; reniform of the usual shape, upright, excavate outwardly, gray, with dark center. Lines marked by black and pale costal dots. Fringes fuscuous with a pale line at base. Thorax and head concolorous with fore wings, shaded with reddish; palpi black at the sides. Hind wings white, with white fringes and diffusely shaded with fuscous along exterior border. Beneath, hind wings white, fore wings pale fuscous. *Expanse* 42 mil.

AGROTIS CATENULA n. sp.

All the tibiæ spinose; male antennæ brush-like. Allied to *muraenula;* differs in color, and t. p. line not followed by white dots. Gray white, indistinctly olivaceous or ochraceous, concolorous; thorax immaculate. Palpi with black scales on basal and second joint at the sides. Lines indicated by black costal spots. Orbicular, a black mark; reniform, reduced, black. Exterior line broken into black dots, a large dot on internal margin and costa. Half-line indicated; t. a. line incomplete; subterminal obsolete; a maginal row of black points. Fringes concolorous. Hind wings pellucid white, with white fringes clouded with fuscous along external margin, and with the veins soiled. Beneath whitish; cell of primaries fuscous; a discal lunule and faint exterior line; a black dot on hind wings. *Expanse* 36 mil.

AGROTIS DECIPIENS n. sp.

All the tibiæ spinose. Rather slender bodied and long winged. Belongs to *Ammoconia*, since the thorax shows a sharp mesial ridge. Leaden gray, concolorous, the median space clouded with blackish. Orbicular large, rounded or slightly oblique, gray, or with darker center; reniform large, upright, slightly mesially constricted. Lines indistinct, double; half-line black, single. Subterminal space gray, in one specimen this and the internal margin shows a faint brownish tinge. Subterminal line commencing with a blackish shade and then running outwardly and near the margin, leaving the apices gray. Beneath with a faint purplish tinge. Breast purplish black. Wings with common line, double on primaries, marked on the veins

on hind wing, and faint discal dots. Male antennæ simple, ciliate. *Expanse* 38 mil.

AGROTIS MINIMALIS n. sp.

Allied to *placida*, but reddish like *cupida*. Fore tibiæ unarmed. Orbicular small, round, paler, with dark center; reniform small, dark. Median shade diffuse, continuous, evident below reniform. Lines single, blackish, followed by pale shades. Subterminal space dark red and contrasting with pale terminal. A terminal row of dots, fringes concolorous. Hind wing fuscous with concolorous fringes. Head and thorax reddish, concolorous. Abdomen fuscous, flattened, with reddish anal hairs. Wings beneath fuscous, shaded with red, with common line distinct on secondaries, on primaries marked on costa. Discal dots better marked on hind wings. Palpi black on sides. *Expanse* 33 mil.

AGROTIS VERTICALIS n. sp.

Allied to *tessellata* and *campestris*. Hind wings of the male white, like *albipennis;* of the female, white, dusted with fuscous; in the male, a narrow fuscous bordering before the white interlined fringes. Fore wings smooth, dusky gray. Lines geminate, black; basal half-line distinct, and like the anterior line, with an included pale streak. Orbicular large, ovate, decumbent, neatly black-ringed, the ring finely edged inwardly with pale. Reniform upright, ringed as orbicular, well-sized; both stigmata concolorous. Cell shaded before the orbicular, and centrally and again beyond the reniform, with reddish-brown in the female; in the male this is absent, or replaced by a faint blackish shading. Subterminal space shaded with reddish brown, or blackish on costa, where it includes pale ante-apical costal points. Posterior line distinct on costa above the reniform, where it is like the other lines; below, it becomes faint and denticulate. Subterminal line as in *campestris*, pale. Terminal space blackish, leaving the apex paler. Two specimens similarly sized with *campestris*.

PYRRHIA STILLA n. sp.

Bright orange red, allied to *angulata*, rather than to *exprimens*. Base of primaries bright smooth orange, without markings. Median shade strongly contrasting, deep brown, forming a mesial band, acutely angulate on cell, even, diffuse exteriorly. Stigmata obsolete. Exterior line as in *angulata*, obsolete on costa. Subterminal subobsolete. Fringes with a bright red tint. Hind wings light yellow with blackish lunule, blackish at base, with a broad, vague, blackish band, tinged with reddish outwardly. Beneath yellow; fringes on primaries red; a red exterior band touched with blackish inferiorly; a discal lunule. Secondaries with a diffuse red exterior band, faint discal mark, above which costa touched with red. *Expanse* 36 mil.

To the preceding descriptions by Mr. Grote, is added the following by Mr. Geo. D. Hulst, of Brooklyn, N. Y., which completes the list of new species of *Noctuidæ* taken at Idaho Springs, Colorado, by the Kansas University Scientific Expedition of 1879:

CATOCALA PURA n. sp.

Expands three inches. Head gray; palpi gray, black on tips; thorax gray, collar and tegulæ edged with indistinct shading; body gray, with a brownish tinge; anal tuft lighter. Fore wings with ground color very light, giving much the same general appearance as *Semirelicta*; surface squamose; markings generally indistinct. Base a little more darkly marked, making an indistinct basal dash; subreniform closed; t. p. line with the two main dentations spreading and not largely produced, the lower especially, and with the dentations beneath these somewhat exaggerated, giving an irregularly-serrated appearance; submarginal line quite distinct, and against the white surface color showing very clearly its serrations; fringe gray. Hind wings red as in Briseis, median band as in *Californica*, but narrower, and prolonged hardly more than two-thirds across the wing; fringe pure white. There is no shading of red on the outer edge or the apex of the wing. Underneath the wings are much as in *Californica*, but with the median band narrowed, and ending posteriorly in a round bulb.

DESCRIPTION OF A NEW SPECIES OF CHRYSOPHANUS.

BY W. H. EDWARDS, COALBURGH, WEST VA.

C. SNOWI.

Male: Expands 1.2 inch.

Upper side copper-red, very nearly the hue of *C. Americana;* and as in that species, having the hind margins of all wings broadly fuscous; costa of primaries fuscous, primaries have a transverse discal of six or seven small black spots or points, four of which are in an oblique straight line from costa to median; the others a little within this line in the median interspaces; at the end of cell a long black spot, and a second, minute, at one-third the distance from arc to base.

Secondaries have a slightly sinuous discal row of similar spots, and between this and the margin on posterior half of the wing are indistinct fuscous spots.

Under side of primaries reddish-ochraceous on disk, gray over costal and hind margins and at base; a submarginal row of small fuscous spots; the discal row repeated, a little enlarged; the spots in cell repeated, the one on arc made up of two confluent round spots.

Secondaries gray with a reddish tint, the base and inner margin dusted black, a submarginal row of small black spots, the one next to anal angle largest, and nearly covered with orange, the next two a little dusted orange; behind each of these three is a black point; the discal spots repeated; in cell three spots, and two on costal margin.

Female: Expands 1.25 inch.

Color lighter, more yellowish; margins bordered as in male; all spots as in male, but larger; two spots at end of cell on secondaries.

Under side as in male, but there is a third spot in cell of primaries near base; on secondaries there are three distinct spots in line across basal area, and three parallel to these a little beyond, besides two at end of cell—in all eight spots within the discal row.

From two males and one female, taken by Prof. F. H. Snow, above timber line on Gray's Peak, Colorado.

This species is nearest *Cupreus* Edw., but differs in several respects, and partakes of the character of some other American species. It is larger than *Cupreus* (known to me only from Oregon and California). The color of male is almost same as in *Americana*, and in the broad marginal borders there is another point of resemblance; the spots are disposed nearly as in *Cupreus*, but the rows are less regular; so too the color of under side is like *Cupreus*, but the spots are not edged buff, and instead of a complete series of orange spots across secondaries within the margin (much as in *Americana*, only here the spots are confluent), *Snowi* has a series of black spots, one only being almost concealed by orange.

LIST OF COLEOPTERA COLLECTED IN SANTA FÉ CAÑON, NEW MEXICO,

BY THE KANSAS UNIVERSITY EXPEDITION FOR 1880.

BY PROF. F. H. SNOW.

The camp in the vicinity of which the 237 species of Coleoptera in the following list were collected was situated eight miles from the city of Santa Fé, at an elevation of 7,000 feet above the level of the sea. The party was in the field for four weeks, from August 6th to September 3d, and consisted of the family of the writer, together with Mr. Louis L. Dyche and Miss Annie E. Mozley—students of the University of Kansas. My son and daughter, Willie and Mattie, eleven and ten years of age, obtained several species not collected by the other members of the party. Among the new species discovered was a large and polished *Onthophagus*, of which Dr. Le Conte writes that it is "the most extraordinary addition to our fauna discovered for a long time." Three specimens were obtained of the rare and curious *Amphizoa Le Contei*, a species which had not previously been detected within the limits of the United States.

Drs. Le Conte and Horn, to whom I am indebted for many favors in the determination of species, have kindly furnished descriptions of that portion of

the new species which could be published separately without confusion to science.

The conspicuous scarcity in Santa Fé cañon of Chrysomelids and some other families of beetles, as well as of the Lepidoptera, both diurnal and nocturnal, is probably due to the very numerous flocks of sheep and goats, which destroy the food plants of these insects.

LIST OF COLEOPTERA.

CICINDELIDÆ.

12. Cicindela longilabris *Say.*
28. Cicindela vulgaris *Say.*
30b. Cicindela guttifera *Lec.*
51. Cicindela punctulata *Fab.*
51a. Cicindela micans *Fab.*

CARABIDÆ.

72. Omophron americanum *Dej.*
116. Nebria obliqua *Lec.*
155. Carabus serratus *Say.*
160. Carabus tædatus *Fab.*
173. Cychrus elevatus *Fab.*
—. Cychrus Snowi *Lec.* n. sp. (See description by Dr. Leconte, at end of this list.)
200. Pasimachus elongatus *Lec.*
220. Dyschirius globulosus *Say.*
380. Metabletus americanus *Dej.*
397. Cymindis laticollis *Say.*
399. Cymindis abstrusa *Lec.*
428. Calathus ingratus *Dej.*
436. Calathus dubia *Lec.*
457. Platynus sinuatus *Dej. var.*
—. Platynus nivalis *Horn.* n. sp. See description by Dr. Horn, at the end of this list.
481. Platynus cupripennis *Say.*
514. Platynus placidus *Say.*
581. Pterostichus protractus *Lec.*
7522. Pterostichus longulus *Lec.*
638. Pterostichus Lucsotii *Dej.*
685. Amara latior *Kirby.*
701. Amara confusa *Lec.*
704. Amara erratica *Sturm.*
705. Amara lævipennis *Kirby.*
711. Amara terrestris *Lec.*
713. Amara remotestriata *Dej.*
819. Piosoma setosum *Lec.*
894. Bradycellus nigrinus *Dej.*
917. Selenophorus troglodytes *Dej.*
925. Harpalus retractus *Lec.*
926. Harpalus amputatus *Say.*
933. Harpalus compar *Lec.*
940. Harpalus herbivagus *Say.*
945. Harpalus ellipsis *Lec.*
950. Harpalus montanus *Lec.*
955. Harpalus funestus *Lec.*
959. Harpalus ochropus *Kirby.*
976. Stenolophus conjunctus *Say.*
1015. Trechus chalybeus *Mann.*
1059. Bembidium transversale *Dej.*
1062. Bembidium lugubre *Lec.*
1063. Bembidium striola *Lec.*
1065. Bembidium bimaculatum *Kirby.*
—. Bembidium n. sp.
1067. Bembidium lucidum *Lec.*
1072. Bembidium picipes *Kirby.*
1097. Bembidium intermedium *Kirby.*
1114. Bembidium connivens *Lec.*
1116. Bembidium assimile *Gyll.*
1119. Bembidium quadrimaculatum *Linn.*
1143. Tachys nanus *Gyll.*
1156. Tachys incurvus *Say.*

AMPHIZOIDÆ.

1171. Amphizoa Lecontei *Matth.*

DYTISCIDÆ.

1210. Hydroporus nubilus *Lec.*
1227. Hydroporus obesus *Lec.*
1229. Hydroporus striatellus *Lec.*
1261. Hydroporus villis *Lec.*
1279. Laccophilus proximus *Say.*
1281. Laccophilus decipiens *Lec.*
1317. Rhantus binotatus *Harr.*
1334. Ilybius biguttatus *Germ.*
1342. Ilybiosoma regularis? *Lec.*
—. Gaurodytes Austinii *Lec.*
1351. Gaurodytes semipunctatus *Kirby.*
1363. Gaurodytes intersectus *Cr.*
1375. Gaurodytes tristis *Aubé.*
1379. Gaurodytes lugens *Lec.*
1381. Anisomera cordata *Lec.*

HYDROPHILIDÆ.

—. Hydraena n. sp. (?)
1450. Tropisternus nimbatus *Say.*
1453. Tropisternus Californicus *Lec.*
1455. Tropisternus glaber *Hb.*
1457. Tropistermus ellipticus *Lec.*
1481. Laccobius ellipticus *Lec.*
1489. Philhydrus nebulosus *Say.*
1497. Philhydrus diffusus *Lec.*
1504. Philhydrus fimbriatus *Mels.*
1507. Hydrobius fuscipes *Linn.*
1511. Hydrobius scabrosus *Horn.*
1514. Hydrobius infuscatus *Mots.*
1516. Hydrobius subcupreus *Say.*

STAPHYLINIDÆ.

—. Homalota Sp. (?)
—. Placusa Sp. (?)
1647. Tachyusa nigrella *Lec.*
1662. Aleochara bimaculata *Grav.*
—. Aleochara Sp.
—. Tachinus Sp. (?)
1749. Heterothops fumigatus *Lec.*
1752. Quedius explanatus *Lec.*
1771. Creophilus villosus *Grav.*
1782. Staphylinus fossator *Grav.*
1804. Philonthus californicus *Mann.*

1615. Philonthus scybalarius *Nord.*
1816. Philonthus debilis *Grav.*
——. Philonthus triangulum *Fauv.*
7769. Dianous nitidulus *Lec.*
7788. Oxyporus occipitalis (?) *Fauv.*
1972. Bledius ornatus *Lec.*
1988. Platystethus americanus *Er.*
1991. Oxytelus fuscipennis *Mann.*
——. Trogophloeus Sp. (?)
7841. Geodromicus ovipennis *Lec.*

SILPHIDÆ.

2176. Necrophorus marginata *Fab.*
2178a. Necrophorus Hecate *Bland.*
2188. Silpha lapponica *Hb.*
2194. Silpha truncata *Say.*

DERMESTIDÆ.

2392. Dermestes marmoratus *Say.*
2404. Dermestes maculatus *Deg.*
2434a. Orphilus subnitidus *Lec.*

ENDOMYCHIDÆ.

2441. Mycetina morosa *Lec.*

EROTYLIDÆ.

2541. Cypherotylus Boisduvali *Chev.*

COLYDIIDÆ.

8019. Bothrideres montanus *Horn.*

TROGOSITIDÆ.

2688. Tenebrioides corticalis *Mels.*
2698. Ostoma Pippingskoeldi *Mann.*

NITIDULIDÆ.

2729. Carpophilus pallipennis *Say.*
2667. Meligethes ruficornis *Lec.*
2772. Perthalycra Murrayi *Cr.*

CONCINELLIDÆ.

2832. Hippodamia convergens *Guér.*
2848. Coccinella 5-notata *Kirby.*
2853. Cycloneda sanguinea *Linn.*
2864. Anatis subvitata *Muls.*

CISTELIDÆ.

8092. Limnichus analis *Lec.*

ELMIDÆ.

——. Elmis concolor *Lec.* n. sp. See description by Dr. Le Conte, at the end of the list.
8087. Elmis divergens *Lec.*

PARNIDÆ.

1977. Helichus striatus *Lec.*

HISTERIDÆ.

3049. Hister abbreviatus *Fab.*
3053. Hister depurator *Say.*
3134. Saprinus oregonensis *Lec.*
3158. Saprinus fimbriatus *Lec.*
3119. Teretrius montanus *Horn.*

LUCANIDÆ.

3205. Lucanus mazama *Linn.*
3210. Platycerus depressus *Lec.*

SCARABÆIDÆ.

3219. Canthon praticola *Lec.*
——. Onthophagus coproides *Horn.* n. sp. See description by Dr. Horn, at the end of this list.
3247. Onthophagus Hecate *Fabr.*
3255. Aphodius hyperboreus *Lec.*
3261. Aphodius crassulus *Horn.*
3262. Aphodius ursinus *Mots.*
3263. Aphodius ruricola *Mels.*
3269. Aphodius vittatus *Say.*
——. Aphodius n. sp. *near* pectoralis *Lec.*
——. Rhyssemus cælatus *Lec.* n. sp. See description by Dr. Le Conte, at the end of this list.
3381. Trox alternans *Lec.*
3394. Trox atrox *Lec.*
3456. Diplotaxis brevicollis *Lec.*
3560. Listrochelus falsus *Lec.*
3615. Aphonus tridentatus(?) *Say.* Determined from a single elytron found among the debris on the banks of the Santa Fé river.
3619. Aphonus clunalis *Lec.*
3646. Euphoria inda *Linn.*
3659. Cremastochilus Knochii *Lec.*

BUPRESTIDÆ.

3718. Buprestis maculiventris *Say.*
3722. Buprestis lauta *Lec.*
3734. Melanophila Drummondi *Kirby.* Var.
3747. Chrysobothris femorata *Lec.*
3756. Chrysobothris trinervia *Kirby.*
3790. Acmæodera ornata *Fab.*
3791. Acmæodera puchella *Hbst.*

ELATERIDÆ.

3902. Anelastes Drurii *Kirby.*
3953. Cardiophorus longior *Lec.*
8258. Athous cribratus *Lec.*
3983. Cryptohypnus bicolor *Esch.*
3995. Cryptohypnus pectoralis *Say.*
4297. Corymbites rupestris *Germ.*

LAMPYRIDÆ.

8293. Dictyoptera ruficollis *Lec.*
——. Caenia sp.
4450. Photinus corruscus *Linn.*

TELEPHORIDÆ.

4482. Chauliognathus scutellaris *Lec.*

MALACHIDÆ.

4582. Collops bipunctatus *Say.*
4584. Collops 4-maculatus *Fab.* var.
4628. Attalus morulus *Lec.*
——. Pristoscelis comatus *Lec.* n. sp. See description by Dr. Le Conte, at the end of this list.

CLERIDÆ.

4720. Trichodes apivorus *Germ.*
——. Clerus n. sp.
——. Lebasiella discoidea *Lec.* See description by Dr. Le Conte, at the end of this list.
4789. Corynetes rufipes *Fabr.*

PTINIDÆ.

4809. Ptinus interruptus *Lec.*

CERAMBYCIDÆ.

4931. Criocephalus productus *Lec.*
5051. Rhopalophora longipes *Say.*
——. Rhopalophora longipes *Say*, var. A singular variety, in which the prothorax is black instead of red. It is suggested by Dr. Le Conte that this difference in color is perhaps the result of disease.
5068a. Tragidion fulvipenne *Say.*
5120. Xylotrechus undulatus *Say.*

5321. Monohammus maculosus *Hald.*
5377. Acanthocinus obliquus *Lec.*
5378. Acanthocinus spectabilis *Lec.*
5388. Pogonocherus mixtus *Hald.*

CHRYSOMELIDÆ.

5668. Xanthonia 10-notata *Say.*
5672 Heteraspis marcassita *Germ.*
5831. Monoxia guttulata *Lec.*
5875. Graptodera plicipennis *Mann.*
5942. Chaetocnema denticulata *Ill.*

TENEBRIONIDÆ.

6010. Epitragus canaliculatus *Say.*
6068. Asida opaca *Say.*
6127*a*. Eleodes dispersa *Lec.*
6134. Eleodes quadricollis *Esch.*
6137. Eleodes extricata *Say.*
6149. Eleodes nigrina *Lec.*
6161. Eleodes consobrina *Lec.*
6168. Eleodes planipennis *Lec.*
6202. Iphthimus serratus *Mann.*
6244. Blapstinus pratensis *Lec.*
——. Platydema, undetermined species.

ALLECULIDÆ.

6375. Hymenorus obscurus *Say.*
6643. Mycetochares lugubris *Lec.*

OTHNIIDÆ.

6404. Othnius umbrosus *Lec.*

ANTHICIDÆ.

6479. Anthicus floralis *Payk.*

MELANDRYIDÆ.

6552. Zilora hispida *Lec.*
6555. Serropalpus striatus *Helen.*
6568. Hallomenus punctulatus *Lec.*

MORDELLIDÆ.

6578. Anaspis nigra *Hald.*
6658. Mordellistena angusta *Lec.*

MELOIDÆ.

——. Meloe *near* rugipennis *Lec.*
6803. Zonitis atripennis *Say.*
6804. Zonitis flavida *Lec.*
6808. Nemognatha bicolor *Lec.*
6809. Nemognatha lurida *Lec.*
——. Nemognatha lurida *var.*
6824. Nemognatha cribaria *Lec.*
6825. Nemognatha immaculata *Say.*

OEDEMERIDÆ.

——. Ditylus undetermined species.

OTIORHYNCHIDÆ.

8785. Peritaxia rugicollis *Horn.*
8833. Pandeleteius hilaris *Hbst.*

CURCULIONIDÆ.

8950. Cleonus *near* frontalis *Lec.*
8993. Dorytomus brevicollis *Lec.*
9067. Magdalis cuneiformis *Horn.*
9405. Balaninus uniformis *Lec.*

CALANDRIDÆ.

9425. Sphenophorus Ulkei *Horn.*
9467. Cossonus concinnus *Boh.*
9485. Rhyncolus brunneus *Mannh.*
——. Rhyncolus undetermined species.

SCOLYTIDÆ.

——. Platypus n. sp.
9619. Dendroctonus terebrans *Oliv.*
9589. Scolytus Californicus *Lec.*
9637. Hylastes gracilis *Lec.*
9643. Hylurgops rugipennis *Mannh.*

SUMMARY OF SPECIES.

Cicindelidæ	4	Elateridæ	6
Carabidæ	52	Lampyridæ	5
Amphizoidæ	1	Telephoridæ	1
Dytiscidæ	15	Malachidæ	4
Hydrophilidæ	13	Cleridæ	4
Staphylinidæ	21	Ptinidæ	1
Silphidæ	4	Cerambycidæ	8
Dermestidæ	3	Chrysomelidæ	5
Endomychidæ	1	Tenebrionidæ	11
Erotylidæ	1	Alleculidæ	2
Colydiidæ	1	Othniidæ	1
Trogositidæ	2	Anthicidæ	1
Nitidulidæ	3	Melandryidæ	3
Coccinellidæ	4	Mordellidæ	2
Cistelidæ	1	Meloidæ	3
Elmidæ	2	Oedemeridæ	1
Parnidæ	1	Otiorhynchidæ	2
Histeridæ	5	Curculionidæ	4
Lucanidæ	2	Calandridæ	4
Scarabaeidæ	18	Scolytidæ	5
Buprestidæ	7		

Total: families, 41; species.....287

DESCRIPTIONS OF NEW SPECIES OF NORTH AMERICAN COLEOPTERA.

BY DR. JNO. L. LE CONTE AND DR. GEO. H. HORN, OF PHILADELPHIA.

1. Cychrus (Scaphinotus) *Snowi* Lec. Black, without purple tinge. Head impunctured. Prothorax densely punctured, about one-third wider than long. Sides thickened and reflexed, more widely towards the base, which is strongly emarginate in an arc of a circle; tip also emarginate, but less deeply; dorsal line well impressed, transverse impressions deep, basal impressions indistinct, lost in the concavity produced by the reflexed margin. Elytra suboval, not dilated behind, lateral margin strong, wider about the humeri, which are rounded; striæ 14 or 15, distinctly impressed except the outer ones, which are confused; punctures of the striæ deep, distant a little more than their diameter. Flanks of prothorax not punctured; epipleuræ, sides of meso- and metathorax, and first ventral segments coarsely punctured. Length 9 mm.

One male. The front tarsi have the joints 1–3 moderately dilated, and spongy pubescent beneath over the whole surface, as in *C. Andrewsii*. This is a very singular species; the sides of the prothorax are thicker than in any other, and nearly as widely reflexed towards the base, as in *C. elevatus*, though the hind angles are not prolonged, nor is the humeral margin of the elytra as wide: the tarsi, as just stated, are as in *C. Andrewsii*, while the punctured prothorax distinguishes it at first sight from all the other species of the group. Collected in Santa Fé cañon, New Mexico, (altitude, 7,000 feet,) by the Kansas University Scientific Expedition for 1880.

2. Platynus *nivalis* Horn. Slender, elongate, piceous, moderately shining. Head narrow, eyes not prominent. Antennæ nearly half as long as the body. Thorax elongate oval, narrower at base, sides in front arcuate, posteriorly slightly sinuate, hind angles obtuse but distinct, margin narrowly reflexed, disc slightly convex, median line moderately impressed, basal impressions feeble and with the lateral margin slightly punctured. Elytra elongate oval, humeri rounded, apex sinuate, suture at tip slightly dehiscent, sides with narrow reflexed margin, disc feebly convex, moderately deeply striate, striæ finely crenately punctured, intervals slightly convex. Anterior tibiæ with terminal spur stouter than the upper, the tarsus without median groove on the upper side. Length .50 inch; 12.5 mm.

This species belongs to Le Conte's group A., (Bull. Brookl. Ent. Soc. II., p. 45,) and should be placed after *jejunus* Lec., from which it differs more especially in the deep and punctured elytrial striæ. It forms a lead toward *hypolithus* by this character. One specimen, female, collected by Prof. F. H. Snow, in Santa Fé cañon, New Mexico, at an elevation of 7,000 feet.

3. Platynus *sulcipennis* Horn. Moderately elongate, piceous, shining, surface with very faint bronze lustre. Head oval, nearly as wide as the thorax. Antennæ piceous, two basal joints paler, longer than half the body. Thorax cordate, a little longer than wide, sides moderately arcuate, base narrower than apex, hind angles rectangular, margin very narrow, wider at base and nearly vertically reflexed, median groove deep, basal margin punctulate, disc moderately convex and smooth. Elytra oval, humeri rounded, sutural angles obtuse, disc deeply striate, striæ distinctly punctured in the basal region, the punctures gradually finer to tip, intervals flat, the third with three dorsal punctures. Body beneath smooth; legs pale testaceous, the apical third of the femora, and sometimes the posterior tibiæ, piceous. Length, .28 in., 7 mm.

This is one of the most remarkable species in our fauna. Its general form recalls that of *Anchus pusillus*, while the deep and rather broad striæ, with flat intervals, give it an aspect peculiarly its own. The hind angles are rectangular and rather long, and the margin there is almost vertically reflexed. The basal impressions are therefore long and linear. The tarsi are all grooved at the sides, and there is no medial dorsal groove.

The species should be placed in Le Conte's group C., near *æneolus* and *quadratus*.

Occurs in Florida. Collected by Albert Koebele, and given me by Mr. F. G. Schaupp.

4. Elmis *concolor* Lec. Blackish-piceous, antennæ, tibiæ and tarsi dark testaceous. Head finely and densely punctured. Prothorax as finely but less densely punctured, without striæ; not longer than the basal width, gradually narrowed from base to tip, sides straight; base margined, oblique each side, and very obtusely angulated at the middle; all the angles are acute. Scutel smooth, triangular, finely margined. Elytra with moderately impressed, punctured striæ, interspaces feebly punctulate and very finely pubescent. Length, 4 mm.

One specimen. Related to *E. vittatus* and *bivittatus*, but stouter, and without a trace of yellow elytral stripes.

Collected in Santa Fé cañon, New Mexico, by the Kansas University Scientific Expedition for 1880.

5. Onthophagus *coproides* Horn. Broadly oval, convex, black, polished. Clypeus nearly semi-circular, vaguely emarginate at middle, separated from the front by a slight ridge in the line of the suture, surface transversely wrinkled. Front coarsely punctate. Vertex with a strongly elevated transverse ridge arcuate to the front at middle and on each end elevated into a sharp angle or short horn. Thorax broader than the elytra, anteriorly retuse, the vertical portion evenly punctured at middle and sparsely punctured in the concave spaces at the side, disc of thorax moderately densely punctured at middle in front, very obsoletely posteriorly, or almost smooth along the base. Elytra broader than long, each with seven feebly impressed, obsoletely punctured striæ, the outer sinuous; intervals slightly convex, sparsely

obsoletely punctulate. Prothorax beneath at sides, and metasternum at sides, coarsely punctate, each abdominal segment with a row of fine punctures. Anterior tibiæ tridentate. Length, .40–.50 inch; 10–12.5 mm.

The three specimens before me are males, which vary in the development of the cephalic ridges. The anterior tibial spur is arcuate at tip. This is the largest species known in our fauna, as well as the only one with a polished surface. The mentum is acutely emarginate in front. The general resemblance of this species to a small *Copris carolina* has suggested the name.

Collected in Santa Fé cañon, New Mexico (altitude 7,000 feet), by the Kansas University Scientific Expedition for 1880.

6. Onthophagus *brevifrons* Horn. Oval, slightly oblong, robust, convex. Head and thorax more shining, varying in color from bluish to violet or greenish metallic. Clypeus short and broad, very obtuse in front, the margin broadly reflexed, surface coarsely not densely punctured, suture indistinct. Front more densely and finely punctured. Vertex with a feebly-elevated transverse sinuous ridge. Thorax very little wider than the elytra, anteriorly retuse, and concave at the sides, surface coarsely but sparsely punctured, with finer punctures intermixed, more densely punctured at the middle of the protuberance. Elytra broader than long, finely seven-striate, the striæ obsoletely distantly punctulate, the outer stria arcuate, intervals flat, irregularly biseriately punctulate, each puncture with a short, erect hair; surface opaque, finely granulate, and with slight purple lustre. Body beneath sparsely punctate, abdomen with few finer punctures at the sides. Anterior tibiæ quadridentate, the upper tooth smaller. Length, .40 inch; 10 mm. Of this species I have seen four males. It resembles *Janus*, but is larger, more elongate, thorax more retuse in front, and with a differently formed clypeus and cephalic ornamentation.

Collected by Dr. H. A. Brous on the plains of Kansas, also in Texas.

7. O. *cribricollis* Horn. Oval, dark bronze, feebly shining, surface sparsely clothed with short erect hairs. Head with two transverse carinæ the one in the frontal suture, the posterior between the eyes. Cypeus coarsely punctured, anteriorly deeply emarginate, on each side triangularly dentate, front coarsely punctured. Thorax broad, coarse, moderately shining, surface coarsely and deeply but not densely punctate. Elytra finely striate, intervals irregularly and rather densely biseriately punctate. Body beneath smoother than above, very sparsely coarsely punctate. Anterior tibiæ quadridentate. Length .14–.18 inch; 3.5–4.5 mm. This species belongs in the group with *tuberculifrons* and *pennsylvanicus* in which the sexes do not differ in the form of the thorax. The clypeus is more decidedly dentate than in the first species, but it differs from both by the transverse ridges on the head and the very coarsely punctured thorax, resembling in this respect some of the forms of *Janus*.

Collected by Prof. F. H. Snow in Douglas county, Kansas; occurs also in Texas.

8. Rhyssemus *cælatus* Lec. Brown, nearly black. Antennæ and palpi yellow. Head slightly emarginate in front, covered with granules, vertex with two oblique lines nearly meeting, and a slight elevation in front of them. Prothorax slightly wider than long, sides straight, margined; hind angles and base rounded, the latter distinctly margined; disc verrucose, with four transverse grooves, of which the first and second are entire; the third is the widest and deepest, and is expanded at the middle into a triangular impression, which divides the two posterior elevated ridges. Elytra oblong, feebly rounded on the sides, striæ double, catenately punctured, interspaces with two rows of small granules. Length 2.5 mm. One specimen. Resembles *Rh. riparius* Horn, but the second transverse groove of the prothorax is entire.

Collected in Santa Fé cañon, New Mexico, by the Kansas University Scientific Expedition for 1880; also found by Mr. E. A. Schwarz, at Cheyenne, Wyoming.

9. Rhyssemus *sonatus* Lec. Black, opaque. Head and prothorax finely and densely granulate, the former convex, without ridges; emarginate in front, as usual, with the angles well defined; prothorax one-half wider than long; sides broadly rounded, margined, narrowed and subsinuate near the base, which is broadly rounded and not margined; transverse grooves very feeble, the first and second entire, the third and fourth connected with a very slight dorsal channel. Elytra oblong, scarcely rounded on the sides; striæ double and catenately punctured, as usual; interspaces narrow, subcostate, each with two series of granules. Very distinct by the obsolete impressions of the prothorax, which are very much less apparent than in *Rh. Californicus.*

One specimen was found by Mr. A. Bolter, near Chicago.

10. Lebasiella *discoidea* Lec. Head, prothorax, antennæ and legs bright ferrugineous; discoidal spot of prothorax black, club of antennæ, knees, and ends of tarsal joints blackish; elytra blue, densely and strongly punctured; under surface of trunk and abdomen black. Length 5.5 mm.

One specimen, collected in Santa Fé cañon, New Mexico, by the Kansas University Scientific Expedition for 1880. Resembles *L. maculicollis,* but differs by the head, legs and part of antennæ being ferruginous, and by the elytra more densely punctured.

11. Pristoscelis *comatus* Lec. Elongate, black, with a leaden lustre, clothed with long erect hairs. Head strongly not densely punctured, antennæ with the fourth, sixth and eighth joints a little wider than the adjoining ones, last joint longer, slender and acute at tip. Prothorax not wider than the head and eyes, very little wider than long, convex, rounded on the sides, which are not serrate; disc strongly not densely punctured. Elytra punctured as strongly but a little more densely than the prothorax. Claws with the appendage acute, one-third shorter than the claw. Length 4 mm. One specimen. Does not resemble any other species in my collection.

Collected in Santa Fé cañon, New Mexico, by the Kansas University Scientific Expedition for 1880.

DOUGLAS COUNTY ADDITIONS TO THE LIST OF KANSAS COLEOPTERA IN 1879 AND 1880.

BY PROF. F. H. SNOW, OF THE UNIVERSITY OF KANSAS.

Of the 144 species included in the following list, 132 were collected in the immediate vicinity of Lawrence, in Douglas county; 10 were taken by Mr. T. B. Ashton, at Tonganoxie, in Leavenworth county, only 13 miles from Lawrence; and 2 were taken in western Kansas. The locality is stated in case of each species not found in Douglas county. These additions increase the list of Kansas Coleoptera to a total of 1855 species, which is the largest list yet published from any State in the Union. In presenting these additions, I desire to recognize the invaluable services of the students in my Zoölogy classes, who have searched the country in all directions for material with which to enrich their own entomological collections, and have invariably allowed me to retain for the University cabinets all species new to the Kansas list. The following students have been especially successful in obtaining new species: Louis L. Dyche, Richard Foster, John E. McCurdy, Frank Prentiss, and Ed. G. Smith.

To Drs. Le Conte and Horn I am indebted for the determination of many of the species.

322. Zuphium americanum *Dej.* Taken by Mr. T. B. Ashton, in Leavenworth county.
342. Loxopeza tricolor *Say.*
371. Tetragonoderus fasciatus *Hald.*
506. Platynus lutulentus *Lec.* Leavenworth county—T. B. Ashton.
609. Pterostichus protensus *Lec.*
733a. Diplochila major *Lec.*
798. Anatrichis minuta *Dej.*
1267. Hydrocanthus iricolor *Say.*
1600. Hoplandria lateralis *Mels.*
1617. Homalota lividipennis *Mann.*
——. Aleochara rufipennis (?). Doubtfully referred to this European species by Dr. Le Conte.
1743. Acylophorus flavicollis *Sachse.*
1744. Acylophorus pronus *Er.*
——. Philonthus sordidus *Fauv.* Ms.
1859. Leptacinus longicollis *Lec.*
1938. Stenus femoratus *Say.*
1983. Bledius emarginatus *Say.*
2010. Geodromicus caesus *Er.*
2208. Ptomaphagus consobrinus *Lec.*
2318. Sacium fasciatum *Say.*
2320. Sacium lunatum *Lec.*
2432. Anthrenus musæorum *Linn.*
2461. Mycetophagus bipustulatus *Mels.*
2470. Litargus infulatus *Lec.*
2523. Mycotretus sanguinipennis *Say.*
2616. Bitoma planicollis *Lec.*
2712. Brachypterus urticæ *Fab.*
2720. Conotelus obscurus *Er.*
2767. Meligethes ruficornis *Lec.*
2781. Amphicrossus ciliatus *Ol.*
2786. Cryptarcha strigata *Fab.*
2787. Cryptarcha liturata *Lec.*
2872. Exochomus marginipennis *Lec.* Taken also in Leavenworth county, by T. B. Ashton.
2873. Exochomus contristatus *Muls.*
2878. Brachyacantha 4-punctata *Mels.*
2930. Scymnus nanus *Lec.*
2937. Nosodendron unicolor *Say.*
——. Cistelid—Genus and species undescribed.
3081. Hister coarctatus *Lec.*
3188. Bacanius punctiformis *Lec.*
3219. Canthon praticola *Lec.* Wallace county.
——. Onthophagus brevifrons *Horn* n. sp. Western Kansas, taken by Dr. H. A. Brous. See descriptions of this and the next species by Dr. Horn in another article in this volume.
——. Onthophagus cribricollis *Horn* n. sp.
3392. Trox laticollis *Lec.*
3415. Dichelonycha elongata *Fab.*
3675. Valgus squamiger *Beauv.* Leavenworth county—T. B. Ashton.
3691. Dicerca pugionata *Germ.*
3814. Agrilus Lecontei *Saund.*
3832. Agrilus obolinus *Lec.*
3850. Throscus Chevrolati *Bonv.*
3853. Throscus sericeus *Lec.*

3965. Horistonotus curiatus *Say.*
4091. Monocrepidius bellus *Say.*
4137. Melanotus clandestinus *Er.*
4161. Melanotus dubius *Lec.*
4176. Limonius auripilis *Say.*
4326. Corymbites inflatus *Say.*
4405. Helodes thoracica *Guér.*
4421. Dictyoptera perfaceta *Say.*
4450b. Photinus lacustris *Lec.*
4451. Photinus flavicollis *Lec.*
4454. Photinus decipiens *Harr.*
4468. Photinus punctulatus *Lec.*
——. Photinus — not described.
4555. Telephorus limbatus *Lec.*
4564. Tytthonyx erythrocephalus *Fabr.*
4585. Collops (*near*) histrio *Er.*
——. Anthocomus sp.
4653. Pristoscelis erythropus *Lec.*
4715. Priocera castanea *Newm.*
4723. Clerus quadrisignatus *Say.* Leavenworth county—T B. Ashton.
4724. Clerus analis *Lec.*
4756. Hydnocera pubescens *Lec.*
——. Orthopleura sp.
4794. Lymexylon sericeum *Harr.*
4847. Xyletinus fucatus *Lec.*
5108. Cyllene lutosus *Lec.*
5159. Necydalis mellitus *Say.* Taken by T. B. Ashton, in Leavenworth county.
5289. Leptura vittata *Germ.* T. B. Ashton, Leavenworth county.
5325. Monohammus confusor *Kirby.* Taken by Frank Prentiss, in the Baptist church where repairs had been made with pine lumber.
5335. Goes pulcher *Hald.* Taken from cherry trees by John McCurdy and Willie Spencer.
5366. Lepturges facetus *Say.* Leavenworth county, T. B. Ashton.
——. Hyperplatys sp.
5491. Bruchus bisignatus *Horn.*
5494. Bruchus distinguendus *Horn.*
5502. Bruchus mixtus *Horn.*
5527. Donacia cuprea *Kirby.*
5662. Cryptocephalus pallidicornis *Suffr.*
——. Cryptocephalus vacuus *Lec.* Ms.
8518. Pachybrachys turbidus *Lec.*
8552. Disonycha rufa *Ill.*
——. Graptodera fuscoænea *Mels.*
5913. Dibolia aerea *Mels.*
5915. Systena frontalis *Fab.*
——. Ceratalitica forticornis.
5955. Stenispa collaris *Baly.* Leavenworth county T. B. Ashton.
5959. Odontota scutellaris *Oliv.*
5960. Odontota bicolor *Oliv.*
6269. Echocerus maxillosus *Fabr.*
6448. Macratria confusa *Lec.*
6450. Notoxus anchora *Hentz.*
6462. Notoxus bicolor *Say*
6486. Anthicus confusus *Lec.*
6603. Mordella insulata *Lec.*
6651. Mordellistena pubescens *Fabr.*
6860. Asclera excavata *Lec.*
——. Trachyphloeus, not named.
8742. Pterocolus ovatus *Fab.*
8800. Phyxelis rigidus *Say.*
8920. Listronotus appendiculatus *Boh.*
8988. Erycus morio *Mannh.*
9003. Pachytychius amoenus *Say.*
9008. Smicronyx obtectus *Lec.*
9038. Lissorrhoptrus simplex *Say.*
9072. Magdalis olyra *Hbst.*
9096. Anthonomus rufipennis *Lec.*
——. Anthonomus, not named.
9147. Tychius aratror *Gyll.*
9158. Gymnetron teter *Fabr.*
9159. Miarus hispidulus *Lec.*
9165. Conotrachelus albicinctus *Lec.*
9200. Chalcodermus collaris *Horn.*
9232. Phyrdenus undatus *Lec.*
9258. Copturus quercus *Say.*
9274. Coeliodes asper *Lec.*
9281. Ceutorhynchus rapæ *Gyll.*
9296. Ceutorhynchus Zimmermanni *Gyll.*
9297. Ceutorhynchus puberulus *Lec.*
9309. Rhoptobaris canescens *Lec.*
——. Baris n. p.
9325. Baris insterstialis *Say.*
9340. Pseudobaris nigrina *Say.*
9360. Centrinus penicellus *Hbst.*
9364. Centrinus punctirostris *Lec.*
9371. Centrinus perscitus *Hbst.*
9378. Centrinus griseus *Lec.*
9394. Barilepton filiforme *Lec.*
9406. Balaninus caryæ *Horn.*
9451. Sphenophorus compressirostris *Say.*
9548. Xyleborus cælatus *Eich.*
——. Micracis unknown species.
9601. Phlœotribus frontalis *Fab.*
9653. Allandrus bifasciatus *Lec.* Leavenworth Co., T. B. Ashton.
9662. Piezocorynus moestus *Lec.*

IRRIGATION IN KANSAS.

BY F. G. ADAMS.

The subject of irrigation is not a new one. Nor is it essentially a scientific subject. The oldest nations of history practiced irrigation; and, in the earliest periods, by methods involving no scientific knowledge. A simple ditch made to turn the water of a brook, and carry it to a level above the adjacent land, whereby it can be spread over, to moisten the cultivated soil of the fields, in the season of crop growing, involves all that is essential to irrigation. Yet where irrigation is done on a larger scale, and broad and deep channels are made, hundreds of miles in length, requiring the construction of aqueducts and bridges and tunnels and reservoirs, at vast expense, and after that a just apportionment of whole rivers of water thus to be brought into use, in its application to thousands of acres of land, and among many thousands of people—in all this, much of science must needs be employed. So in the sinking of wells to great depths, to obtain water for irrigation, scientific investigation is requisite to determine the position of strata, and the reasonable sources of the water supply which is sought. The climatic effects which may accompany the change of the soil, in a district where rainfall is slight, from a state of sterility to one of great productiveness, may be a subject of no little scientific interest.

Is irrigation practicable in Kansas? This is a question which it would seem the facts of science might have long ago helped to solve. If the question has already been solved without such aid, doubtless science may be made to help in carrying forward the work which has been begun *without* its intervention.

Mr. Gannett's tables of elevations, together with the tables of distances on the Atchison, Topeka & Santa Fé Railroad, show the fall in the waters of the Arkansas river, between Hutchinson and the Kansas State line, to be about eight feet to the mile.

The application of the engineer's level through fifteen miles in Sequoyah county, the third county from the western line of the State, on the Arkansas river, shows the fall in the river there to be about seven and a half feet to the mile. At low stages the river banks are about four feet above the water in the channel; and the bottom lands spread out for miles back from the river, at a little more than the same elevation. As the water falls, in the course of the river eastward, so does the adjacent bottom land, seven or eight feet to the mile, through several counties here, perhaps the entire distance from Hutchinson to the west line of the State, and beyond; the uplands, too, have about the same general declivity to the eastward.

In the Arkansas river, four miles above Garden City, in Sequoyah county, and about seventy-five miles from the western line of the State of Kansas, is

an island, a mile or more in length, and it comes so near the northern bank of the river that at a point three-fourths of a mile below the upper end of the island the channel between the island and the main land is but about twenty feet wide. At this point, last February or March, some gentlemen, among whom were Messrs. Landis & Hollinger, of Sterling, and Mr. W. H. Armentrout, of Garden City, under the name of "The Garden City Irrigating Company," threw across this channel a dam of brush-wood and earth. By this means they raised the water in this channel above the dam to the height of nearly five feet, or almost up to the top of the river bank. Here they commenced to dig a ditch eight feet wide and two feet deep. They made the ditch to gradually recede from the river, as they extended it out across the bottom land, so as to run, at the farthest, a mile or two from the river. The ditch is ten miles long.

It was late in June, almost July, before the ditch was so far completed as that water could be used in the irrigation of fields adjacent to it; but, as late as it was, sufficient advantage was derived to crops to bring good results, and the promise of the successful irrigation of large tracts of land in the Arkansas valley, and even on the uplands. In the experiments tried, nothing like fair tests were made, except in a few instances, and that principally in garden patches.

The persons engaged in this experiment did not go about their work with a view of making, in this year's trial, accurate proofs of results; hence no exact evidence appears to be obtainable as to how much of any crop was grown to the acre. Onions and turnips of very large size were still (last week) standing in patches, from which many of the larger, or of earlier growth, had been gathered and sold. Out on the "Great American Desert," turnips sell at $1.25 per bushel, and the temptation to gather and sell, as they became large enough, was of course irresistible. Potatoes of the finest quality and size were being dug, in fields where the stand is very scattering, from the fact that the seed had dried up and the germ perished before the ground received the water so that they could germinate. There are fields of very scattering corn, of good growth and fair-sized ears, which was planted on sod, late in June. There is abundant testimony to the fact that a patch of sweet potatoes, the plants for which were raised in the open ground, with no hot-bed of any sort, and which were set out in July, yielded nearly a thousand bushels to the acre. The statement is, that there was a little more than an acre of ground, and but little less than a thousand bushels of potatoes. There was no real measurement of the ground on which this extraordinary crop was grown, and no account was kept of the number of bushels dug and sold. They sold at $2.50 per bushel, and the money was the main object. The owner of this crop, and of most of the crops irrigated, was away in New Mexico most of the summer, looking after gold mines. He was the only man in the settlement who knew anything by experiment of the modes of the application of water in irrigation; and on his farm, the irriga-

tion was done in quite a hap-hazard manner. In no respect has any pains been taken, by the persons engaged in the enterprise, to prove how much irrigation would produce. But the main point has been established — that is, that water, in sufficient quantities for irrigation, and at moderate cost, can be taken from the Arkansas river by ditches, and carried to fields in the bottom lands, in the valley of that river.

The mode of using the water on the farm of Mr. Worrel, was what is called bed-work irrigation. The land is gently-sloping bottom land. It is laid off in large beds, running in the direction of the slope. The beds are separated by shallow ditches. Skirting the upper end of the entire plat, embracing all the beds, is a main ditch. If it is desired to flood the upper part of any bed, and not the whole of it at once, a furrow is run across the lower end of the portion to be flooded, making a ridge to check the water. Then the water is let from the main ditch of the plat, at the upper end, and the whole of this portion is allowed to become covered with water. Then the water may be allowed to escape into the side ditches, or the supply being cut off, to soak into the ground; or it may be let into another section of the bed, to be in its turn irrigated. On such nearly level land the process is extremely simple, and the work is easily performed.

In the digging of this ditch no engineering was done. The ditch was started a short distance, and water let run in, to see if it would run. Then another portion was dug and tried. Of course a mistake could hardly be made in judging where to run the ditch; having only the main object, and not the best selection, in view. The uniform declivity of the Arkansas river bottom renders it extremely easy to obtain a fall after the water is once brought out upon the bottom land. There are believed to be about six thousand acres of land that can be reached by water from this ditch. An interesting question is, how much land has the ditch actual capacity to irrigate? If the owners proceed upon the plan employed in locating the ditch, that of trial and experience merely, they may meet with disappointment and loss; but doubtless they will in this matter consult the experience of irrigation elsewhere.

Taking the rules of hydraulic engineering as a guide for calculation, and supposing this ditch to have a fall of three feet per mile and a twelve-foot volume of water, its capacity is 153,420 cubic feet of water per hour.

From a lengthy paper on irrigation, in the United States Agricultural Report for 1860, I have been enabled to obtain information for comparison of the Kansas experiments with works of irrigation in other countries.

In the south of France, in Italy and Algeria, where irrigation has long been very extensively practiced, the season of irrigation is, at the maximum, six months; that is, from the first of May to the end of October. Experience has there evolved at least general rules for the computation of the capacity of irrigating canals of various sizes, and the quantity of water required for irrigation; and many other practical matters, the result of long

experience and careful observation, have been determined. As to the required quantity of water, the rule is, one litre of continuous water per second for every hectare: that is, fifty cubic feet of water per hour for one acre of ground, taking the season of irrigation through. The Garden City ditch, then, with a capacity of 153,420 feet per hour, will, by the French rule, irrigate 3,068 acres, or about one-half the area of ground within the reach of the ditch. But this ditch can be easily increased to a size necessary to meet any demand that may be made upon it.

The Garden City experiment has naturally enough excited the interest of the people generally in the section of the upper Arkansas valley, and other canals are already projected. One other has been begun, and will be ready to supply water for irrigation early next spring. This is also by a chartered organization called the "Kansas Irrigating, Water Power and Manufacturing Company." Of this company, Mr. C. J. Jones, of Garden City, was the originator and is the active manager, as he has also been most active in attracting public attention to this practical development of irrigation in Kansas. The canal of this company commences at the west line of Sequoyah county, twelve miles west of Garden City. Its length is about twenty miles. It is already opened for fifteen miles—that is, it is so far made that water has been run through it for that distance. It is to be twenty-two feet wide, and will run four feet of water in depth. The cost of making it is to be not to exceed $250 per mile. Not a cut or a fill is required for the entire distance of twenty miles. The ditching is done by machinery—that is, by plowing and grading machines constructed for railroad grading and canal excavation. This canal was carefully located by a civil engineer. It has a fall of three feet to the mile. It runs clear out on the upland. It is by no means a straight canal; it has many curves, in order to keep the proper level, or rather declivity; but this winding and twisting will perhaps prove no drawback as to its utility when in use. In commencing it, advantage was taken of a time when the ground had been softened by rain for some inches, and a grading plow was run the whole distance on both sides of the contemplated ditch, making two shallow ditches, some six feet wide, leaving a strip within yet untouched. Water has been let into these shallow ditches, testing the correctness of the engineering, and removing all possibility of difficult excavation in the completion of the canal, by reason of dry and hard ground. The earth yet to be excavated can now, at any time, be softened up by sending a flow of water from the river through the shallow preliminary ditches. As remarked by Mr. Jones, "the company has got the heels of this ditch." As may well be supposed, the ground in that region is a little dry and hard at times, especially on the uplands.

The area estimated to be in reach of this canal is 38,000 acres. Applying the French rule before mentioned, its actual capacity for irrigation is about 21,600 acres. It can be easily enlarged at any time.

It is one of the most favorable circumstances connected with this irrigation

undertaking in the Arkansas valley, that the cost of construction of the canal is remarkably light, compared with what must be the cost in Colorado, New Mexico, and other mountainous districts. The Garden City canal probably cost considerably more than $100 per mile. But it was made without machinery; and a number of depressions were crossed, requiring considerable filling, which would not have been necessary had its course been laid with skill. As has been said, the canal of the "Kansas Irrigating, Water Power and Manufacturing Company" is being made at a cost of $250 per mile; and this is twenty-two feet wide and four feet deep, while that of the Garden City Company is but eight feet wide and two feet deep.

The Calusa canal, in Piedmont, Italy, is twenty miles long, as is to be the Kansas canal, and the capacity is about the same, the Calusa canal being eighteen feet broad at the bottom, twenty-six feet at the surface of the water, and having a depth of three and a half feet. Its capacity is the irrigation of 18,000 acres. That of the Kansas canal is to be 21,600 acres. The Calusa canal cost $8,500 per mile. In this statement of its cost, however, there appears to be included that of fifty-nine bridges, twenty-six aqueducts and two tunnels. In the cost of the Kansas canal—$250 per mile—no account is taken of any such accessories. The future may develop the necessity of bringing some of these things into the estimates.

In the Arkansas valley, too, the labor of irrigation, of attending the fields and conducting the water upon crops, must be far less than in hilly districts. Owing to the flatness of the land, large areas can be much more quickly and completely flooded than where the land is more sloping.

The area of land irrigated, or rather partially irrigated, in Sequoyah county the present year, did not exceed 100 acres. There are several thousand acres now plowed and ready for irrigation within the reach of the ditches, which will afford water early next spring; the price of water fixed by the irrigation companies is one dollar per acre for the year, the water to be brought by the ditch-owners to the farms of those to be furnished with it.

The spring rise in the Arkansas begins from the first to the middle of May. The river keeps up high until September or October. It is lowest through the winter and early in the spring. It is the observation of those who have become interested in these irrigation experiments, that there is seldom less than five hundred cubic feet of water in the channel and within reach of the irrigation canals in the upper counties in the Arkansas valley in Kansas. Last April, at Garden City, for four or five days, there was less than that volume, owing to a strong south wind prevailing for that time. But through the season of irrigation a much larger volume of water flows through that portion of the river.

At some distance below Sequoyah county the water sometimes disappears, and is not seen at all above the sandy bed of the river. This occurred last spring, as far up as at a point thirty miles below Garden City. But last spring being a time of general drouth in Colorado and New Mexico, the Ar-

kansas river was unusually low. Yet it may well be supposed that no very correct observations or calculations have been made as to the amount of water the Arkansas river will afford for irrigation. The great breadth of channel and usually shallow current will render correct estimates of the quantity of water flowing within a given time quite difficult.

That there is a large area of land, in these upper counties, within comparatively easy reach of the water of the Arkansas river, there is now no question. Mr. Jones, whose opinion is worthy of great credit, estimates the area in Sequoyah county alone to be 256,000 acres. This area under irrigation and cultivation would afford sustenance to a very large population; especially taking into account the facilities for manufacturing, which will at the same time be afforded.

Should there be any question as to the fertility of the soil to be irrigated in the Arkansas valley, that is at once set at rest by the fact that the waters with which the fields are to be flooded contain the highest elements of fertility. They are charged with the washings of a thousand hill and mountain-sides, and are thick with vegetable sediment; from that which, settled upon the land, makes a slimy paste, to the decaying and crumbling twig of the mountain pine, as large as the little finger. Such deposits are now strewn over a hundred acres of land in Sequoyah county. No one can make an examination of the irrigation begun there without bringing some of it away on his boots.

Alluding again to irrigation in other countries, in the hilly region of Piedmont not less than 2,500 cubic feet of water per second are rendered available for irrigation, and the extent watered is 180,000 acres. The whole irrigated region of Piedmont is 1,500,000 acres; the amount of cultivated land is 890,454 acres; the total of actually irrigated land is 306,613 acres.

The total quantity of water utilized in Piedmont is 8,290 cubic feet per second, and the area is covered by a network of canals more than 1,200 miles long. The Cavo Morocca canal, in Lombardy, is 150 miles long, and its cost was $8,000 per mile. The total superficial irrigated region here is 2,500 square miles, or 1,750,000 acres. The slopes range from about 5 to 12 feet a mile. More than 27,000 cubic feet of water are discharged per second. The irrigating season commences in March and terminates in September. The months when the water is in the greatest demand are May, June, July, and August. The average annual fall of rain is given as 37 inches, of which 28 inches fall during the seven irrigating months.

The sum of the statement of irrigation for Lombardy, is a total area of 6,500,000 acres in the irrigated district, of which there are irrigated in summer, 1,061,292 acres; in winter, 12,837 acres; in all, 1,074,129 acres; or about one-sixth of the whole, or one-fifth of the productive area. The great Government canals in Lombardy are 133 miles long. Besides the main lines there are 353 branches, and probably a network of 3,550 miles. East of the Addy they reach 700 or 800 miles, thus making the entire length of

the canals of Lombardy 4,500 miles. The discharge of water amounts to 15,118 cubic feet per second, while the whole amount of the discharge of rivers, etc., is 30,000 feet per second. In the entire valley of the Po, Piedmond and Lombardy, there is an extent of irrigation of 1,600,000 acres, or nearly 24,000 cubic feet per second. This view of the canals of Piedmont and Lombardy will serve to show to what a wide extent irrigation is carried on in Italy.

Irrigation is nowhere conducted on so grand a scale as in British India. Some of the canals are like mighty rivers, and a vast extent of country receives the benefit of their waters for agricultural purposes. The first canal dates back to the fourteenth century. The principal canals in India are those on the river Jumna, west, of the Eastern Jumna, of the Sutlej, and of the Ganges. The whole length of the main lines of the Western Jumna canal is 445 miles. The total area of the country traversed is 3,784,385 acres. Of this, the irrigated portion is 859,902 acres. The Eastern Jumna has a system of distribution canals measuring 500 miles. The area of the land so watered is 160,000 acres.

Irrigation is extensively carried on in many countries. It is carried on in countries where the need of it and the facilities for it are less than is now apparent in western Kansas. It has been the chief purpose of this paper to call attention to experiments in irrigation in Kansas—experiments which give a promise of good results towards a permanent settlement and cultivation of considerable portions of that part of Kansas over which a doubt, to say the least, has hitherto hung. It seems that it would be worthy the employment by the State of engineering science to determine how far there is, in the Arkansas river and its branches, and in the Smoky Hill and Republican and their branches, a water supply which can be employed in irrigation, and how far such water can be turned into reservoirs upon uplands, to be utilized in manufacturing as well as irrigation. It does not seem improbable that such work done would pay back to the State many-fold its cost. A scientific survey has long been needed for Kansas, and here is another reason why it should not be delayed.

KANSAS WEATHER SERVICE.

BY PROF. J. T. LOVEWELL, WASHBURN COLLEGE, TOPEKA.

Meteorology has been raised to the dignity of a science by virtue of combined systems of observation over vast areas, corresponding in some degree with the magnitude of the phenomena they undertake to interpret. It has come to be recognized that the problems of meteorology are vast enough to tax the energies and resources of nations; hence, in modern times the foremost

governments of the earth have established weather bureaus, and provided a regular system for collecting the facts and arranging them in such a form that scientific deductions and discussions become possible.

Owing to geographical and topographical conditions, as well as to the enterprise of our meteorologists, it has been reserved for the United States to develop the most complete and accurate system of weather observation the world has yet seen. The system, however, is in its infancy, and splendid as have been the achievements of Reed, Maury, Meyer and others, much yet remains to be done to bring it to full development.

There are always to be found in every community willing observers of the weather. It is a subject which concerns everybody; it is the grand *piéce de resistance* on which we fall back when other topics of conversation fail. It affords endless opportunities for guessing and infinite variety in treatment. It is by no means certain that scientific knowledge will in any wise improve the weather as a social theme, for by the methods of science we have nothing to conjecture which can be ascertained by actual observation, and the wise man will remain discreetly silent where knowledge fails. We can, however, afford to sacrifice the poetry of weather and its myths for the sake of truth, and there is a way of utilizing the universal interest in the subject so as to obtain a multitude of willing observers of weather phenomena, each of whom will help in establishing the basis of fact out of which all valuable theories grow and on which they rest.

This organization of volunteer work has been most successfully shown to be possible, by the labors of Hinrichs in Iowa and Nipher in Missouri, while the New York Herald Weather Department has shown what a great metropolitan newspaper can accomplish.

Here in Kansas, we have quite a number of points where meteorological notes have been accurately and systematically kept for quite a number of years. Foremost among these are Professor Snow's valuable observations at the State University, and the Signal Service observations at Leavenworth and Fort Dodge. There are many other points in the State where observations are taken occasionally, with commendable accuracy, but their value is lost from lack of continuity and system. Most observers grow tired of the monotonous record of daily weather changes, and do not perceive the value and interest of such records when long continued and systematically arranged. Even then it requires the comparison and compilation of many such records, taken at points suitably distributed throughout the State, to be able to understand their real significance and importance.

Last winter, it was resolved by the Topeka Scientific Club to try to systematize and utilize the volunteer weather observations heretofore taken in Kansas, and at the same time to establish observations in every county of the State. For this purpose they organized the Kansas Weather Service. It was thought best, if possible, to enlist the combined talent of the State in the enterprise, and secure at least the sympathy, if not the active coöperation,

of the U. S. Signal Service. Correspondence was accordingly entered into with the authorities at Washington, which resulted in the loan of necessary instruments for the central station. This was located at Washburn College, and the President and other officers of this institution have given very material assistance in carrying out these plans. A commodious observatory has been secured in the college building, and the college laboratory and cabinets supplement the instrumental appliances.

The writer undertook to act as director of this weather service, and with aid of Mr. Chase and Mr. Hilton, of the Topeka Scientific Club, observers were engaged in different parts of the State, instructions and blanks were issued, and arrangements made for supplying thermometers and rain-gauges.

This preliminary work was completed last July, and since then a careful record has been kept at the central station, and reports published. About twenty-five other stations are now established, and from some of these the reports have been sent in with considerable regularity and accuracy. There is evidence that much patience and labor are requisite to secure observations at desirable points that will be satisfactory. There exists, however, much reason for encouragement, and the work will be steadily pushed as fast as the resources at our command will allow. It must be remembered that all the labor is done without remuneration, and in time snatched from the intervals of other occupations. This is true of the director as well as all the observers, and not only must time be given freely, but expenses for printing, paper and postage must be provided. These have thus far been met by the liberality of the Scientific Club and by Washburn College. The ends to be gained are worthy all the effort, since we shall secure data for a more accurate study of the ordinary weather phenomena than has hitherto been possible. We shall also have a trained body of observers to note the facts in any occasional phenomena, like tornados, earthquakes, remarkable temperatures and rainfalls. There will be valuable notes on the phenomena relating to vegetation, rainfall and temperature, which cannot fail to be more accurate than any yet published, and they will be useful in determining the exact resources and advantages of different parts of the State. The question whether our rainfall increases with the cultivation of the soil, interesting alike in its scientific and economic aspects, can only be settled by such observations as we propose to publish.

Finally, when these reports are taken in connection with similar reports of the two great contiguous States of Missouri and Iowa, their combined value will be greatly enhanced for purely scientific purposes. We shall have a larger consecutive area of the earth's surface under minute and systematic observation than exists elsewhere to my knowledge. We can trace storms in their track over a level country, from western Kansas to the Mississippi river, many hundred miles in any direction, and can thus determine their laws and the ways of avoiding them, if this be possible. At the next annual meeting of the Academy it is hoped that the organization of the Kansas

Weather Service will be so far perfected that no question will exist as to its permanence. It is not, of course, expected that the fruits of its work will be gathered or apparent the first or the second year. It may be changed in many details when experience shows such changes profitable, and ultimately should be considered a permanent feature of the Agricultural Department of the State, and be under State management. The object of bringing it at this time before the Academy, is to present its claim to scientific interest, and to secure sympathy and coöperation in a work which, if done at all, must be the labor of many hands.

METEOROLOGICAL SUMMARY.

PROF. F. H. SNOW'S ANNUAL REPORTS AS METEOROLOGIST TO THE STATE BOARD OF AGRICULTURE.

STATION: Lawrence, Kas. Latitude, 38°, 57′, 25″; longitude, 95°, 15′; elevation of barometer and thermometers, 875 feet above the sea level, and 5 feet above the ground; rain-guage on the ground; anemometer 105 feet above the ground, on the dome of the University building, 1,200 feet above the sea level.

SUMMARY FOR 1878.

The chief characteristics of the weather of 1878 were the large and well-distributed rainfall, the high average temperature, the absence of great extremes of temperature, the long period of immunity from severe frosts, the comparative lightness of the winds, and low temperature and great snowfall of the month of December.

TEMPERATURE.

Mean temperature of the year, 55.33°, which is 2.37° above the mean of the ten preceding years. The highest temperature was 98°, on the 15th of July and 24th of August; the lowest was 6° below zero, on the 18th and 25th of December, giving a yearly range of 104°. Mean temperature at 7 A. M., 49.46°; at 2 P. M., 64.32°; at 9 P. M., 55.31°.

Mean temperature of the winter months, 32.41°, which is 2.79° above the average winter temperature; of the spring, 57.37°, which is 4.58° above the average; of the summer, 75.13°, which is 1.2° below the average; of the autumn, 56.13°, which is 3.87° above the average.

The coldest month of the year was December, with a mean temperature of 23.05°; the coldest week was December 21st to 27th, with mean temperature, 11.18°; the coldest day was December 24th, with mean temperature, 4.3°. The mercury fell below zero seven times, all of which were in December.

The warmest month of the year was July, with a mean temperature of 78.45°; the warmest week was July 10th to 16th, with mean temperature,

83.90°; the warmest day was July 14th, with mean temperature, 85.6°. The mercury reached or exceeded 90° on 35 days, viz.: 15 in July, 14 in August, and 6 in September.

The last light frost of spring was on May 14th; the first frost of autumn was on October 18th, giving an interval of 157 days entirely without frost. The last severe frost of spring was on March 4th; the first severe frost of autumn was on October 18th, giving an interval of fully seven months, or 228 days, without severe frost. No frost or cold weather during the year caused any damage to fruit or fruit buds.

RAIN.

The entire amount of rain, including melted snow, was 38.39 inches, which is 3.48 inches above the average annual amount for the ten preceding years. Either rain or snow fell on 107 days. The longest interval without rain during the growing season, (March 1st to October 1st,) was 12 days, July 8th to 20th. The number of thunder showers was 38. These occurred in all months of the year except November and December. There were three light hail storms.

SNOW.

The entire depth of snow was 25½ inches, of which 2½ inches fell in February, 1 inch in October, 2 inches in November, and 20 inches in December. The last snow of spring was on March 29th; the first snow of autumn was on October 26th. The single storm of December 12th and 13th brought 14 inches of snow—this being the greatest snowfall on our eleven years' record.

FACE OF THE SKY.

The average cloudiness of the year was 40.65 per cent., which is 4.52 per cent. below the average. The number of clear days (less than one-third cloudy) was 190; half-clear days (from one-third to two-thirds cloudy), 93; cloudy (more than two-thirds), 82. There were 59 entirely clear, and 37 entirely cloudy days. The clearest month was August, with an average cloudiness of 19.19 per cent.; the cloudiest month was February, with an average of 54.63 per cent. The mean cloudiness at 7 A. M. was 47.32 per cent.; at 2 P. M., 44.99 per cent.; at 9 P. M., 29.66 per cent.

DIRECTION OF WIND.

During the year, three observations daily, the wind was from the N. W. 327 times; S. W., 281 times; S. E., 134 times; N. E., 136 times; E., 60 times; S., 55 times; N., 53 times; W., 28 times; calm, 21 times. The north wind (including northwest, north and northeast) outnumbered the south winds (including southwest, south and southeast), in the ratio of 516 to 470.

VELOCITY OF THE WIND.

The number of miles traveled by the wind during the year was 125,793, which is 16,078 miles less than the average annual distance for the past six years. This gives a mean daily velocity of 344.47 miles, and an average

hourly velocity of 14.34 miles. The highest hourly velocity was 60 miles, on April 9th; the highest daily velocity was 919 miles, on March 8th; the highest monthly velocity was 15,106, in October. The three windiest months were March, May and October; the three calmest months were February, July and August. The average hourly velocity of the wind at 7 A. M. was 13.44 miles; at 2 P. M., 16.39 miles; at 9 P. M., 14.07 miles.

BAROMETER.

Mean height of the barometer, 29.067 inches; mean at 7 A. M., 29.090 inches; at 2 P. M., 29.047 inches; 9 P. M., 29.063 inches. Maximum, 29.735 inches, on December 24th; minimum, 28.335, on April 9th; yearly range, 1.400 inches. The highest monthly mean was 29.268 inches, in December; the lowest was 28.851 inches, in April. The barometer observations are corrected for temperature and instrumental error.

RELATIVE HUMIDITY.

The average atmospheric humidity for the year was 70.4; at 7 P. M., 81.26; at 2 P. M., 50.82; at 9 P. M., 77.22. The dampest month was July, with mean humidity, 78.27; the driest month was November, with mean humidity, 62.60. There were only five fogs during the year. The lowest humidity for any single observation was 18.2, on November 23d.

The following table gives the mean temperature, the extremes of temperature, the velocity of the wind, the percentage of cloudiness, the relative humidity, and the rainfall, for each month of the year 1878.

Months.	*Mean temperature.*	*Maximum temperature.*	*Minimum temperature.*	*Miles of wind.*	*Mean cloudiness.*	*Relative humidity.*	*Rainfall, in inch's.*
January	33.97	55.0	7.5	9.996	47.42	73.40	3.05
February	40.22	66.0	15.5	7.393	54.63	76.50	2.86
March	50.90	81.0	27.0	11.994	40.86	67.64	2.67
April	58.60	82.0	36.0	11.482	38.22	66.03	5.48
May	62.60	85.0	38.5	12.207	52.90	70.90	5.66
June	69.79	89.0	50.0	9.187	48.66	74.80	5.67
July	78.48	98.0	58.0	7.974	31.29	78.27	4.30
August	77.14	98.0	56.0	8.188	19.19	74.60	2.22
September	67.58	94.5	41.0	11.972	30.66	66.40	2.51
October	55.55	87.0	20.0	15.106	28.92	63.70	0.44
November	45.87	72.0	22.0	11.198	42.00	62.60	1.55
December	23.05	53.0	—6.0	9.096	55.75	65.70	1.98

SUMMARY FOR THE YEAR 1879.

The chief characteristics of the weather of 1879 were the high average temperature of the spring and autumn months, the long period of immunity from severe frost, the deficient rainfall of March, May and August, the extraordinary rainfall of November, and the low percentage of cloudiness. It is worthy of note that, notwithstanding the deficiency of rain in the months above named, the crops have been abundant in all the agricultural sections of the State.

TEMPERATURE.

Mean temperature of the year, 54.67°, which is 1.51° above the mean of the eleven preceding years. The highest temperature was 99.5°, on August 4th; the lowest was 16° below zero, on the 4th of January—giving a yearly range of 115.5°. Mean temperature at 7 A. M., 48.61°; at 2 P. M., 63.71°; at 9 P. M., 53.18°.

Mean temperature of the winter months, 27.93°, which is 1.94° below the average winter temperature; of the spring, 58.04°, which is 4.83° above the average; of the summer, 76.05°, which is .47° below the average; of the autumn, 56.71°, which is 3.90° above the average.

The coldest month of the year was January, with mean temperature, 23.49°; the coldest week was January 2d to 8th, with mean temperature, 3.90°; the coldest day was January 3d, with mean temperature, 9.3° below zero. The mercury fell below zero 13 times, of which 10 were in January and 3 in December.

The warmest month was July, with mean temperature 79.14°; the warmest week was July 5th to 11th, with mean temperature 83.54°; the warmest day was July 22d, with mean temperature 86.9°. The mercury reached or exceeded 90° on 48 days, viz.: 4 in May, 12 in June, 16 in July, 14 in August, and 2 in September.

The last light frost of spring was on April 18th; the first light frost of autumn was on October 19th—giving an interval of 184 days entirely without frost. The last severe frost of spring was on April 4th; the first severe frost of autumn was on October 24th—giving an interval of nearly seven months, (203 days,) without severe frost. The severe cold weather of January and the frost of April 3d were very destructive to the buds of peaches, pears and early apples in many localities, but there was generally a fair crop of small fruits and winter apples.

RAIN.

The entire amount of rain, including melted snow, was 32.68 inches, which is 2.70 inches below the average annual amount for the eleven preceding years. Either rain or snow fell on 90 days, 12 less than the average. The longest interval without rain, during the growing season, (March 1st to October 1st,) was 19 days, from April 30th to May 19th. The number of thunder showers was 36, of which 9 were in June and 1 in December. There were 5 light hail storms.

SNOW.

The entire depth of snow was 10.35 inches, of which .85 inch fell in January, 4.50 inches in February, 2 inches in November, and 3 inches in December. The last snow of spring was on February 23d; the first snow of autumn was on November 28th.

FACE OF THE SKY.

The average cloudiness of the year was 40.01 per cent., which is 4.75 per cent. below the average. The number of clear days (less than one-third cloudy), was 179; half-clear days (from one-third to two-thirds cloudy), 114; cloudy, (more than two-thirds), 72. There were 61 entirely clear and 35 entirely cloudy days. The clearest month was August, with an average cloudiness of 28.92 per cent.; the cloudiest month was December, with an average of 51.83 per cent. The mean cloudiness at 7 A. M. was 44.09 per cent.; at 2 P. M., 46.27 per cent.; at 9 P. M., 29.67 per cent.

DIRECTION OF WIND.

During the year, three observations daily, the wind was from the S.W. 272 times, N.W. 238 times, S. E. 158 times, S. 130 times, N. E. 112 times, E. 90 times, N. 71 times, W. 16 times, calm 8 times. The south winds, including southwest, south, and southeast, outnumbered the north winds, including northwest, north, and northeast, in the ratio of 560 to 421.

VELOCITY OF THE WIND.

The number of miles traveled by the wind during the year was 124,768, which is 14,160 miles less than the average for past six years. This gives a mean daily velocity of 341.83 miles, and a mean hourly velocity of 14.24 miles. The highest hourly velocity was 60 miles, on February 25th and March 18th; the highest daily velocity was 960 miles, on March 8th; the highest monthly velocity was 13,787 miles, in March. The three windiest months were March, November, and December; the three calmest months were June, July, and August. The average hourly velocity at 7 A. M. was 12.78 miles; at 2 P. M., 16.29 miles; at 9 P. M., 14.03 miles.

BAROMETER.

Mean height of barometer column, 29.127 inches; at 7 A. M., 29.150 in.; at 2 P. M., 29.103 in.; at 9 P. M., 29.126 in.; maximum, 29.745 in., on January 3d; minimum, 28.534 in., on December 28th; yearly range, 1.211 in. The highest monthly mean was 29.253 in., in January; the lowest was 29.024 in., in May. The barometer observations are corrected for temperature and instrumental error.

RELATIVE HUMIDITY.

The average atmospheric humidity for the year was 67.13; at 7 A. M., 77.86; at 2 P. M., 50.11; at 9 P. M., 73.41. The dampest month was January—mean humidity 76; the driest month was March—mean humidity 56.1. There were 10 fogs during the year. The lowest humidity for any single observation was 12.3, at 2 P. M., on March 9th—less than one-eighth of saturation.

In presenting this report, the writer desires to acknowledge his indebtedness to Prof. H. S. S. Smith, for taking the observations during seven weeks' absence in the summer vacation.

The following table gives the mean temperature, the extremes of temperature, the velocity of the wind, the per cent. of cloudiness, the relative humidity, and the rainfall, for each month of the year 1879:

Months.	*Mean temperature.....*	*Maximum temperature.....*	*Minimum temperature.....*	*Miles of wind.....*	*Mean cloudiness .....*	*Relative humidity.....*	*Rainfall, in inches....*
January	23.49	53.0	—16.0	8,309	43.98	76.0	0.37
February	34.06	74.0	5.0	10,097	39.04	64.7	0.41
March	48.22	87.0	11.0	13,787	46.02	56.1	0.37
April	56.40	84.0	20.0	11,231	49.67	61.0	4.18
May	69.50	93.0	43.0	12,057	37.20	60.9	1.60
June	73.22	97.0	45.0	9,498	41.33	69.9	7.14
July	79.14	97.5	62.5	6,980	34.89	73.8	3.66
August	75.78	99.5	49.0	6,815	28.92	63.8	1.03
September	65.40	92.0	42.0	10,237	37.00	64.0	3.57
October	60.46	87.5	25.5	10,952	31.94	71.2	2.81
November	44.26	76.5	16.0	11,964	38.33	70.6	5.15
December	26.23	65.5	—9.0	12,821	51.83	74.0	2.39
Mean	54.67	83.8	24.5	10,397	40.01	67.1	2.72

SUMMARY FOR THE YEAR 1880.

The year 1880 surpassed all previous years of our record in the warmth of its January, the coldness of its November, its maximum monthly and hourly velocity of wind, and the earliness of its spring and winter. Maples were in blossom February 11th, and genuine winter weather began November 11th, continuing without interruption to the end of the year.

The temperature, wind velocity and relative humidity were *above*, while the fall of rain and snow and the cloudiness were *below*, the annual averages.

The most remarkable meteorological event of the year was the wind storm of March 27th, which filled the air to a great height with an almost impalpable dust, and obscured the sun during the entire day after 10 A. M.

TEMPERATURE.

Mean temperature of the year, 54.01°, which is .72° above the mean of the twelve preceding years. The highest temperature was 101°, on August 18th; the lowest was 12° below zero, on the 29th of December, giving a yearly range of 113°. Mean at 7 A. M., 48.10°; at 2 P. M., 63.55°; at 9 P. M., 52.20°.

Mean temperature of the winter months, 34.88°, which is 5.17° above the average winter temperature; of the spring, 56.63°, which is .33° below the average; of the summer, 74.92°, which is 1.60° below the average; of the autumn, 49.56°, which is 3.58° below the average.

The coldest month of the year was December, with mean temperature, 25.84°; the coldest week was December 25th to 31st, with mean temperature, 9.41°; the coldest day was December 28th, with mean temperature 2.7° below zero. The mercury fell below zero only twice during the year, on December 28th and 29th.

The warmest month was July, with mean temperature 75.75°; the warmest

week was August 13th to 19th, with mean temperature 82.61°; the warmest day was August 18th, with mean temperature 86°. The mercury reached or exceeded 90° on 41 days, viz.: 1 in April, 7 in May, 8 in June, 13 in July, and 12 in August.

The last light frost of spring was on April 30th; the first light frost of autumn was on September 13th, giving an interval of 136 days (nearly 5 months) entirely without frost. The last severe frost of spring was on March 20th; the first severe frost of autumn was on October 17th, giving an interval of 211 days (nearly 7 months) without severe frost. No frost or cold weather during the year did any damage to fruit buds or trees. Both large and small fruits were produced abundantly.

RAIN.

The entire amount of rain, including melted snow, was 32.65 inches, which is 2.34 below the average annual amount for the 12 preceding years. Either rain or snow fell on 89 days—12 less than the average. On 11 of these days the quantity was too small for measurement. The longest interval without rain during the growing season (March 1st to October 1st) was 18 days—from August 2d to 19th. The number of thunder showers was 29. There were 4 light hail storms, all of which occurred in March, April and May.

SNOW.

The entire depth of snow was 7 inches, which is about one-third of the average. Of this amount, 3 inches fell in March, 2½ inches in November, and 1½ inches in December. The last snow of spring was on March 15th; the first snow of autumn was on November 16th.

FACE OF THE SKY.

The average cloudiness of the year was 40.15 per cent., which is 4.18 per cent. below the average. The number of clear days (less than one-third cloudy) was 196; half-clear days (from one-third to two-thirds cloudy), 87; cloudy (more than two-thirds), 83. There were 65 days on which the cloudiness averaged .8 or more. There were 51 entirely clear, and 33 entirely cloudy days. The clearest month was February, with an average cloudiness of 24.94 per cent.; the cloudiest month was December, with an average of 54.08 per cent. The mean cloudiness at 7 A. M. was 44.79 per cent.; at 2 P. M., 44.20 per cent.; at 9 P. M., 31.48 per cent.

DIRECTION OF WIND.

During the year, three observations daily, the wind was from the S.W. 324 times; N.W., 242 times; S. E., 158 times; S., 113 times; N. E., 107 times; E., 61 times; N., 55 times; W. 37 times; calm, *once*. The south winds (including southwest, south and southeast) outnumbered the north winds (including northwest, north and northeast) in the ratio of 595 to 404.

VELOCITY OF THE WIND.

The number of miles traveled by the wind during the year was 146,039, which is 9,154 miles above the annual average for the seven preceding years. This gives a mean daily velocity of 399.01 miles, and a mean hourly velocity of 16.62 miles. The highest velocity was at the rate of 80 miles an hour, from 3.30 to 3.45 A. M., on April 18th. The highest daily velocity was 1,121 miles, on March 27th and April 18th; the highest monthly velocity was 16,709 miles, in April. The three windiest months were March, April and May; the three calmest months were July, August and September. The average hourly velocity at 7 A. M. was 15.30 miles; at 2 P. M., 18.44 miles; at 9 P. M., 15.70 miles.

BAROMETER.

Mean height of barometer column, 29.123 inches; at 7 A. M., 29.148 inches; at 2 P. M., 29.099 inches; at 9 P. M., 29.123 inches; maximum, 29,791 inches, on November 21st; minimum, 28.303 inches, on April 18th; yearly range, 1.488 inches. The highest monthly mean was 29.295 inches, in November; the lowest was 29.019 inches, in May. The barometer observations are corrected for temperature and instrumental error.

RELATIVE HUMIDITY.

The average atmospheric humidity for the year was 67.9; at 7 A. M., 79.2; at 2 P. M., 49.9; at 9 P. M., 74.6. The dampest month was December — mean humidity, 76.5; the driest month was April — mean humidity, 53.4. There were 18 fogs, of which 9 were in January, and 4 in December. The lowest humidity for any single observation was 11.8, at 2 P. M. on April 14th — less than one-eighth of saturation.

The following tables give the mean temperature, the extremes of temperature, the velocity of the wind, the per cent. of cloudiness, the relative humidity, the rainfall (including melted snow), and the depth of snow, for each month of the year 1880, and a comparison with the twelve preceding years:

1880.	*Mean temperature.*	*Maximum temperature.*	*Minimum temperature.*	*Miles of wind.*	*Mean cloudiness.*	*Relative humidity.*	*Rain, inches.*	*Snow, inches*
January	41.23	67.0	20.5	12,861	48.49	73.8	1.80	0.0
February	37.58	69.0	8.0	11,861	24.94	64.5	0.73	0.0
March	42.38	79.0	2.5	13,841	44.94	63.4	2.03	3.0
April	56.92	93.0	31.0	16,709	34.56	53.4	1.75	0.0
May	70.59	94.0	52.0	14,108	40.43	62.6	4.11	0.0
June	73.57	96.0	50.5	12,629	37.00	68.1	4.10	0.0
July	75.75	98.0	54.0	9,312	28.23	68.3	2.34	0.0
August	75.45	101.0	50.5	8,863	45.70	70.8	7.93	0.0
September	64.59	85.0	42.0	10,124	32.00	73.2	2.46	0.0
October	52.52	81.0	28.0	12,745	39.24	66.3	2.73	0.0
November	31.58	65.5	7.5	11,325	51.77	74.4	2.24	2.5
December	25.84	61.0	—12.0	11,661	54.08	76.5	0.43	1.5
Mean	54.01	82.5	27.9	12,169	40.15	67.9	2.72	0.6

Comparison with previous years:

Year.	Mean temperature.	Maximum temperature.	Minimum temperature.	Miles of wind.	Mean cloudiness.	Relative humidity.	Rain, inches.	Snow, inches.	Rainy days.
1868	53.36	101.0	*—16.5	.....	42.35	.....	37.42	27.50	77
1869	50.99	96.0	—5.0	.....	49.23	.....	38.51	18.00	105
1870	54.50	102.0	—10.0	.....	47.88	68.4	31.38	9.50	100
1871	54.30	103.0	—6.0	.....	47.37	.....	33.23	29.75	120
1872	51.90	97.0	—18.0	.....	44.33	64.4	32.63	23.25	116
1873	52.71	104.0	—26.0	154,508	42.46	64.0	32.94	26.50	101
1874	54.20	108.0	—3.0	145,865	45.54	65.5	28.87	43.00	99
1875	50.60	99.0	—16.5	145,316	44.81	65.5	28.87	5.00	106
1876	52.76	98.0	—5.0	148,120	41.27	66.8	44.18	24.75	102
1877	54.16	99.0	—9.0	113,967	47.12	72.6	41.09	15.50	126
1878	55.33	98.0	—6.0	125,793	40.65	70.4	38.39	25.50	107
1879	54.67	99.5	—16.0	124,768	40.01	67.1	32.68	10.35	90
1880	54.01	101.0	—12.0	146,039	40.15	67.9	32.65	7.00	89
Mean, 13 years,	53.34	100.4	—13.0	138,047	44.09	67.2	34.83	20.43	103

*The minus sign denotes temperature below zero.

PRELIMINARY LIST OF THE HYMENOPTERA OF KANSAS.

BY PROF. F. H. SNOW, UNIVERSITY OF KANSAS.

The following species of Hymenoptera have been incidentally collected by the writer and his students, during the summer vacations of the past ten years, while chiefly engaged in making collections of *Lepidoptera* and *Coleoptera*. The list might have been considerably enlarged by including species known to have been taken in Kansas by Eastern collectors. But it has been thought best to include only those species which are contained in the University cabinets, the locality of whose capture is exactly known. The extreme eastern and western portions of the State have contributed the material here designated. The species from Douglas county were taken in the immediate vicinity of the city of Lawrence, at an elevation of nearly 1,000 feet above the level of the sea. The species from Wallace county were taken at various camping-places on the so-called "Plains," at an elevation of about 3,500 feet.

I am greatly indebted to Mr. E. T. Cresson, of Philadelphia, for valuable aid in the determination of the species.

It is hoped that this neglected order of insects may in the future receive a larger share of attention from Kansas entomologists, not only with a view to enlarging the list of species, but especially for the purpose of increasing our knowledge of their habits.

APIDÆ: BEES.

Apis mellifica *Linn.* Douglas county.
Bombus Pennsylvanicus *DeGeer.* Douglas and Wallace counties.
Bombus separatus *Cresson.* Douglas county.
Emphor bombiformis *Cresson.* Douglas county.

Apathus elatus *Fab.* Douglas county.
Anthidium maculifrons *Sm.* Wallace and Gove counties.
Anthidium notatum *Latr.* Douglas county.
Anthidium concinnum *Cr.* Wallace county.
Anthophora Smithii *Cr.* Wallace county.
Anthophora Walshii. Douglas county.
Anthophora occidentalis *Cr.* Wallace county.
Diadasia enavata *Cr.* Wallace county.
Melissodes albata *Cr.* Douglas and Wallace counties.
Melissodes confusa *Cr.* Wallace county.
Melissodes menuachus *Cr.* Douglas and Wallace counties.
Melissodes pruinosa *Say.* Douglas and Wallace counties.
Melissodes densa *Cr.* Wallace county.
Melissodes australis *Cr.* Wallace county.
Melissodes aurigenia *Cr.* Wallace county.
Melissodes Coloradensis *Cr.* Wallace county.
Melissodes obliqua *Say.* Douglas and Wallace counties.
Melissodes n. sp. Douglas county.
Melissodes rustica *Cr.* Douglas county.
Melissodes binotata *Say.* Douglas county.
Melissodes condigna *Cr.*
Melecta interrupta *Cr.* Douglas and Wallace counties.
Cœlioxys dubitata *Sm.*
Cœlioxys octo-dentata *Say.* Douglas county.
Cœlioxys n. sp. Douglas county.
Cœlioxys deplanata *Cr.*
Epeolus occidentalis *Cr.* Wallace county.
Epeolus fumipennis *Say.* Wallace county.
Epeolus lunatus *Say.* Douglas county.
Epeolus remigatus *Fabr.* Douglas and Wallace counties.
Epeolus lectus *Cr.*
Megachile bucephala *Sm.*
Megachile femorata *Sm.* Douglas county.
Megachile acuta *Sm.* Douglas county.
Megachile lanuginosa *Sm.* Douglas county.
Megachile latimanus *Say.* Wallace county.
Megachile pruina *Sm.* Wallace county.
Megachile brevis *Say.*
Megachile fortis *Cr.*
Megachile deflexa *Cress.*
Megachile Sayi *Cress.*
Nomada zebrata *Cr.*
Nomada electa *Cr.*
Nomada accepta *Cr.*
Panurgus marginatus *Cr.*

ANDRENIDÆ.

Andrena maculifrons *Cr.* Wallace county.
Nomia Nortoni *Cr.* Douglas county.
Nomia n. sp. Douglas county.
Eunomia marginipennis *Cr.* Wallace county.
Agapostemon tricolor *St. Farg.* Douglas county.

Agapostemon Texanus *Cr.* Douglas and Wallace counties.
Augochlora fervida *Sm.* Douglas county.
Augochlora pura *Say.*
Halictus occidentalis *Cr.* Douglas and Wallace counties.
Halictus Sp. Douglas county.
Sphecodes Sp. Wallace county.
Sphecodes dichroa *Sm.* Wallace county.
Colletes n. sp. Douglas county.

VESPIDÆ: WASPS.

Vespa maculata *L.* Douglas county.
Vespa diabolica *Sauss.* Douglas county.
Polistes fuscatus *Fab.* Douglas county.
Polistes fuscatus var. pallipes *St. Farg.* Douglas county.
Polistes variatus *Cr.* Douglas and Wallace counties.
Polistes rubiginosus *St. Farg.* Douglas county.

EUMENIDÆ.

Pterochilus 5-fasciatus *Say.* Douglas and Wallace counties.
Odynerus annulatus *Say.* Wallace county.
Odynerus arvensis *Sauss.* Douglas and Wallace counties.
Odynerus anormis *Say.* Douglas and Wallace counties.
Odynerus quadrisectus *Say.* Douglas county.
Odynerus foraminatus *Sauss.* Douglas and Wallace counties.
Odynerus campestris *Sauss.* Douglas county.
Odynerus unifasciatus *Sauss.* Douglas county.
Odynerus tigris *Sauss.* Wallace county.
Monobia quadridens *Linn.* Douglas county.
Eumenes Bollii *Cr.* Douglas county.
Eumenes Smithii *Sauss.* Douglas county.
Eumenes fraterna *Say.* Wallace county.

CRABRONIDÆ: WOOD WASPS.

Cerceris venator *Cr.* Wallace county.
Cerceris bicornuta *Guerin.* Douglas county.
Cerceris compacta *Cr.* Douglas county.
Cerceris clypeata *Dahl.* Douglas county.
Cerceris deserta *Say.* Douglas county.
Eucerceris canaliculatus *Say.* Wallace county.
Philanthus punctatus *Say.* Douglas county.
Philanthus ventilabris *Fab.* Wallace county.
Crabro Packardii *Cr.* Wallace county.
Trypoxylon clavatum *Say.* Douglas county.
Trypoxylon n. sp. Wallace county.

NYSSONIDÆ.

Gorytes rufoluteus *Packd.* Douglas county.
Nysson Texanus *Cr.* Wallace county.
Larra unicincta *Say.* Douglas and Wallace counties.
Larra abdominalis *Say.* Wallace county.
Stizus brevipennis *Walsh.* Douglas county.
Stizus speciosus *Drury.* Douglas and Wallace counties.
Stizus grandis *Say.* Wallace county.
Stizus nevadensis *Cr.* Wallace county.

BEMBECIDÆ.

Mondedula obliqua *Cr.* Wallace county.
Monedula ventralis *Say.* Wallace county.
Bembex fasciata *Fab.* Douglas and Wallace counties.
Bembex nubilipennis *Cr.* Douglas county.
Bembex monodonta *Say.* Douglas county.

LARRIDÆ.

Astata nubecula *Cr.* Wallace county.
Astata bicolor *Say.* Wallace county.
Tachytes abdominalis *Say.* Wallace county.
Tachytes pepticus *Say.* Douglas and Wallace counties.
Tachytes texanus *Cr.* Wallace county.
Tachytes validus *Cr.* Douglas and Wallace counties.
Tachytes distinctus *Sm.* Wallace county.
Tachytes mandibularis *Patton.* Wallace county.
Larrada analis *Fab.* Wallace county.
Larrada argentata *Beauv.* Douglas county.

SPHEGIDÆ: MUD WASPS.

Prionony x atrata *St. Farg.* Douglas county.
Sphex ichneumonea *Fab.* Douglas and Wallace counties.
Sphex Pennsylvanica *Linn.* Douglas county.
Chlorion cæruleum *Linn.* Douglas and Wallace counties.
Pelopæus cæruleus *Linn.* Douglas county.
Pelopæus cementarius. Douglas county.
Ammophila gracilis *St. Farg.* Douglas and Wallace counties.
Ammophila Aberti *Hald.* Wallace county.

POMPILIDÆ.

Pepsis dubitata *Cr.* Douglas county.
Ceropales fraternus *Sm.* Wallace county.
Priocnemis terminatus *Say.* Wallace county.
Priocnemis flammipennis *Sm.* Wallace county.
Pompilus algidus *Sm.* Wallace county.
Pompilus maurus *Cr.* Douglas and Wallace counties.
Pompilus Philadelphicus *St. Farg.* Douglas county.
Pompilus conicus *Say.* Douglas county.
Pompilus fulvicornis *Cr.* Douglas and Wallace counties.
Pompilus interruptus *Say.* Wallace county.
Pompilus tropicus *Fab.* Wallace county.
Pompilus atrox *Dahl.* Douglas county.
Pompilus unifasciatus *Say.* Douglas county.
Pompilus ferrugineus *Say.* Douglas county.
Pompilus notatus *Fab.* Douglas county.
Pompilus formosus *Say.* Wallace county.

SCOLIADÆ.

Elis plumipes *Drury.* Douglas county.
Scolia bicincta *Fab.* Douglas county.
Scolia Le Contei *Cr.* Wallace county.
Tiphia inornata *Say.* Wallace and Gove counties.
Myzine hamata *Say.* Douglas county.
Myzine 6-cincta *Fab.* Douglas county.

MUTILLIDÆ: STINGING ANTS.

Mutilla creusa *Cr.* Wallace county.
Mutilla aureola *Cr.* Wallace county.
Mutilla Californica *Rad.* Wallace county.
Mutilla hexagona *Say.* Wallace county.
Mutilla brazoria *Blake.* Wallace county.
Mutilla occidentalis *Cr.* Wallace county.
Mutilla simillima *Sm.* Wallace county.
Mutilla propinqua *Cr.* Wallace county.
Mutilla fulvohirta *Cr.* Wallace county.
Mutilla Sayi *Blake.* Wallace county.
Mutilla bioculata *Cr.* Wallace county.
Mutilla ferrugata *Fab.* Wallace county.
Mutilla cajaca *Blake.* Wallace county.
Mutilla fenestrata *St. Farg.* Douglas and Wallace counties.
Agama glabrella *Cr.* Wallace county.
Agama clara *Cress.* Douglas county.
Mimosa (Myrmosa?) unicolor *Say* (?). Douglas county.

CHRYSIDIDÆ.

Chrysis parvula *Fab.* Wallace county.
Chrysis sp. Douglas county.

ICHNEUMONIDÆ: ICHNEUMONS.

Pelecinus polycerator *Drury.* Douglas county.
Thyreodon n. sp. Douglas county.
Ophion purgatus *Say.* Douglas county.
Toxoneuron seminigrum *Cr.* Wallace county.
Thalessa lunator *Fabr.* Douglas county.
Thalessa atrata *Fabr.* Douglas county.
Undetermined gen. and sp. Douglas county.
Trogus exesorius *Brullé.* Douglas county.
Trogus obsidianator *Br.* Douglas county.
Ichneumon longulus *Cr.* Douglas county.
Ichneumon w-album *Cr.* Douglas county.
Ichneumon laetus *Br.* Douglas county.
Ichneumon jocundus *Br.* Douglas county.
Ichneumon devinctus *Say.* Wallace county.
Ichneumon vittefrons *Cr.* Douglas county.
Ichneumon viola *Cr.* Douglas county.
Ichneumon cincticornis *Cr.* Wallace county.
Ichneumon grandis *Br.* Douglas county.

TENTHREDINIDÆ.

Tremex columba *Fab.* Douglas county.
Cimbex Americana *Peck.* Douglas county.

FORMICARIÆ: ANTS.

Formica sp. Douglas county.
Camponotus sp. Douglas county.

ADDITIONS TO THE LIST OF KANSAS LEPIDOPTERA.

BY PROF. F. H. SNOW, UNIVERSITY OF KANSAS.

In vol. IV. of the Transactions of this Academy (1875), the writer published a "Catalogue of the Lepidoptera of Eastern Kansas," giving brief descriptions of 503 species, and mentioning their food-plants as far as known. During the five years since the publication of that catalogue he has been able to add 140 species to the list, 116 of which were taken in Douglas county, within five miles of Lawrence, and about thirty miles west of the Missouri river. Fourteen species were taken in western Kansas, in Wallace and Gove counties, by the various scientific expeditions of the Kansas University; seven were taken at Topeka, by Prof. E. A. Popenoe; two at Tonganoxie, by T. B. Ashton; and one at Columbus, by Geo. F. Gaumer. Including these additions, the Lepidoptera of Kansas are classified as follows:

Diurnal Lepidoptera, or Butterflies	84
Sphingidæ, or Hawk Moths	31
Aegeriadæ, or Aegerians	7
Zygaenidæ	7
Bombycidæ, or Silkworm Moths	79
Noctuidæ, or Owlet Moths	294
Phalænidæ, or Geometrids	72
Pyralidæ, or Snout Moths	52
Tortricidæ, or Leaf-rollers	10
Tineidæ, or Tineids	6
Pterophoridæ, or Plume Moths	1
Total number of species thus far catalogued	643

The additions to the previous list are the following:

DIURNALS.

Pieris rapæ *Linn.* European cabbage butterfly; abundant at Lawrence since March, 1880.

Gonepteryx Lycide *Godt.* Lawrence; L. L. Dyche.

Thecla M-album *Boisd.* Columbus; Geo. F. Gaumer.

Lycæna Melissa *Edw.* Western Kansas, in Wallace and Gove counties.

Lycæna Acmon *West.-Hew.* Wallace county.

Ancyloxypha Waco *Edw.*

Pamphila Uncas *Edw.* Wallace and Gove counties.

SPHINGIDÆ.

Sesia diffinis *Grote.*

Aellopos Titan *Cramer.*

Proserpinus gauræ *Sm.-Abb.* Wallace county.

Sphinx Canadensis *Boisd.* Leavenworth county; T. B. Ashton.

AEGERIADÆ.

Aegeria — three undetermined species. Wallace county.

ZYGÆNIDÆ.

Ctenucha venosa *Walk.*

Lycomorpha pholus *Drury.*

Thyris lugubris *Boisd.* Topeka; Prof. E. A. Popenoe.

BOMBYCIDÆ.

Cisthene subjecta *Walk.*
Arctia Blakei *Grote.*
Cerura n. sp. Wallace county.
Notodonta bilineata *Pack.* Topeka; Prof. E. A. Popenoe.

NOCTUIDÆ.

Acronycta occidentalis *Grote.*
Acronycta lobeliæ *Guen.*
Acronycta luteicoma *G. & R.*
Acronycta afflicta *Grote.*
Acronycta albarufa *Grote.*
Acronycta exilis *Grote.*
Acronycta sperata *Grote.*
Acronycta lithospila *Grote.*
Agrotis alternata *Grote.*
Agrotis incivis *Guen.*
Mamestra distincta *Hubn.*
Mamestra trifolii *Esp.*
Mamestra detracta *Walk.*
Mamestra quadrannulata *Morr.*
Hadena delicata *Grote.*
Hadena costalis *Grote.*
Hadena passer *Guen.*
Hadena stipata *Morr.*
Hadena versicolor *Morr.* Topeka, Prof. E. A. Popenoe.
Hadena arna *Guen.*
Prodenia flavimedia *Harvey.*
Prodenia lineatella *Harvey.*
Platysenta atriciliata *Grote.*
Leucania pseudargyria *Guen.*
Orthodes cynica *Guen.*
Graphiphora sp.
Glæa viatica *Grote.*
Lithophane ferrealis *Grote.*
Ingura fiabella *Grote* n. sp.
Ingura oculatrix *Guen.*
Calpe Canadensis *Bethune.*
Hypsoropha monilis *Fabr.*
Phyprosopus callitrichoides *Grote.*
Acopa perpallida *Grote*—n. sp. Wallace county.
Plusia verruca *Fabr.* Taken "at sugar," by L. L. Dyche.
Plusia ou *Guen.*
Schinia trifascia *Hubn.*
Porrima sanguinea *Geyer.*
Rhododipsa volupia *Fitch.* Gove county.
Lygranthæcia Packardi *Grote.* Topeka, Prof. E. A. Popenoe.
Lygranthæcia jaguarina *Grote.* Wallace county.
Heliothis nuchalis *Grote.*—n. sp.
Tarache lactipennis *Harvey.* Wallace county.
Eustrotia synochitis *G. & R.*
Eustrotia musculosa *Guen.*
Lithacodia bellicula *Hubn.*

Xanthoptera coccineifascia *Grote.* Topeka, Prof. Popenoe.
Syneda Howlandii *Grote.* Wallace county.
Bolina versabilis *Harvey.*
Bolina nigrescens *G. & R.*
Bolina ochreipennis *Harvey.*
Brotis vulneraria *Hubn.* Wallace county.
Stictoptera divaricata *Grote.*
Catocala Nebraskæ *Dodge.*
Catocala habilis *Grote.* Tonganoxie; T. B. Ashton.
Catocala Anna *Grote.*
Catocala Clintonii *Grote.*
Catocala Whitneyi *Dodge.*
Catocala Frederici *Grote.*
Allotria elonympha *Hubn.*
Pleonectyptera pyralis *Hubn.*
Remigia hexastylus *Harvey.*
Phurys vinculum *Guen.*
Phurys lima *Guen.*
Trama arrosa *Harvey.*
Eutoreuma tenuis *Grote.*
Pheocyma lunifera *Hubn.*
Homoptera penna *Morr.*
Pseudanthracia cornix *Guen.*
Spargaloma umbrifascia *Grote.*
Homopyralis discalis *Grote.*
Epizeuxis æmula *Hubn.*
Epizeuxis americalis *Gnen.*
Pityolita pedipilalis *Guen.*
Zanclognatha ochreipennis *Grote.*
Zanclognatha cruralis *Guen.*
Renia discoloralis *Guen.*
Renia centralis *Grote.*
Renia Belfragei *Grote.*
Renia (?) plenilinealis *Grote.*
Bomolocha abalienalis *Walk.*

PHALÆNIDÆ.

Eupithecia miserulata *Grote.*
Petrophora diversilineata *Hubn.*
Phibalapteryx latirupta *Walk.*
Heterophleps triguttata *H.-S.*
Stegania pustularia *Guen.* Wallace county.
Eois ferrugata *Pack.* Topeka; Prof. E. A. Popenoe.
Acidalia perirrorata *Pack.*
Acidalia enucleata *Guen.*
Paraphia subatomaria *Guen.*
Cymatophora humaria *Guen.*
Hyperetis nyssaria *Guen.*
Hyperetis var. amicaria *H.-S.*
Antepione depontanata *Grote.*
Endropia madusaria *Walk.*
Endropia bilinearia *Pack.*

Endropia pectinaria *Guen.*
Endropia obtusaria *Guen.*
Metanema inatomaria *Guen.*

PYRALIDÆ AND TINEIDÆ.

Margaritana quadristigmalis *Guen.*
Botis 5-linealis *Grote.*
Botis phœnicealis *Hubn.*
Botis adipaloides *G. & R.*
Eurycreon rantalis *Gnen.*
Eurycreon onythesalis *Walk.*
Eurycreon cereralis *Zeller.*
Eurycreon sticticalis *Linn.*
Crocidophora tubercularis *Led.*
Scoptocnema integra *Zeller.*
Chilo crambidoides *Grote* n. sp.
Crambus lachellus *Zincken.*
Crambus edonis *Grote* n. sp.
Crambus vulvivagellus *Clem.*
Myelois albiplagiatella *Pack.* Topeka; Prof. Popenoe.
Conchylis Ridingsana *Robinson.* Wallace county.
Mochlocera Zelleri *Grote.*
Fruva tortricina *Zeller.*
Anaphora sp. Topeka; Prof. Popenoe.
Nola minuscula *Zeller.*

The writer desires to acknowledge his indebtedness to Messrs A. R. Grote and W. H. Edwards, for many favors in the determination of species. The *new* species of moths in this list have already been described by Mr. Grote, in the "Canadian Entomologist."

ORNITHOLOGY OF RILEY COUNTY, KANSAS.

BY DR. C. P. BLACHLY, MANHATTAN.

I have in the following lists put down only those that I know to be here, receiving valuable aid from my friend, Prof. E. A. Popenoe, in the way of identifying birds; also from Prof. F. H. Snow. Many of my specimens have been brought in by my farmer friends, and some of the hunters of Manhattan, so that I have not had the opportunity I desired to study their habits. The lists will be increased as I have opportunity, and it is safe to say that the number of species that will be found will easily exceed two hundred.

Two species have been taken that are not on Prof. Snow's catalogue, while quite a number of those marked rare have been found. Three new ones (the Great Blue Heron, King Rail and Little Black Rail) have been found breeding, and two (the Wood Pewee and White Heron) taken under circumstances such as to make it almost certain that they breed.

My list now embraces one hundred and eighty-two species, of forty-three families.

TURDIDÆ: Thrushes and Mocking Birds.

Turdus migratorius Linn. American robin. Chiefly migratory, but is occasionally found in flocks in sheltered places during winter. It is growing more abundant each year.

Turdus mustelinus Gm. Wood thrush. Common in summer.

Turdus Swainsoni Cab. Olive-backed thrush.

Mimus polyglottus Linn. Mocking bird. Common summer resident.

Mimus Carolinensis Linn. Catbird. Common summer resident.

Harporhynchus rufus Linn. Brown thrush. Common summer resident.

SAXICOLIDÆ: Bluebirds.

Sialia sialis Linn. Eastern bluebird. Abundant early in spring, and stays late in the fall. Occasional winter resident. Breeds.

SYLVIIDÆ: Sylvias.

Polioptila cærulea Linn. Blue-gray gnat-catcher. Two specimens captured.

PARIDÆ: Titmice.

Lophophanes bicolor Linn. Tufted titmouse. Inserted on the authority of Prof. E. A. Popenoe.

Parus atricapillus var. *septentrionalis* Harr. Common resident.

SITTIDÆ: Nuthatches.

Sitta Carolinensis Gm. White-bellied nuthatch. Common.

TROGLODYTIDÆ: Wrens.

Troglodytes aëdon Vieill. House wren. Common summer resident.

Cistothorus palustris Wilson. Long-billed marsh wren.

Cistothorus stellaris Licht. Short-billed marsh wren.

ALAUDIDÆ: Larks.

Eremophila alpestris Forst. Horned lark. Abundant; early arrivals from the north being the last of September. It is known to breed occasionally as early as March, retiring in April.

MOTACILLIDÆ: Wagtails.

Anthus ludovicianus Gm. Titlark. Migratory; common.

SYLVICOLIDÆ: Warblers.

Protonotaria citræa Bodd. Prothonotary warbler. A single specimen taken.

Dendræca æstiva Gm. Yellow-poll warbler. Abundant in summer.

Dendræca coronata Linn. Yellow-rumped warbler. Seen as late as Oct. 17th, 1880.

Seiurus noveboracensis Gm. Small-billed water-thrush.

Oporornis formosus Wils. Kentucky warbler. Taken the first of June.
Geothlypis trichas Linn. Maryland yellow-throat.
Icteria virens Linn. Yellow-breasted chat. Common summer resident.
Setophaga ruticilla Linn. Redstart. A young bird taken Aug. 16, 1878.

TANAGRIDÆ: Tanagers.

Pyranga rubra Linn. Scarlet tanager. Common summer resident.

HIRUNDINIDÆ: Swallows.

Hirundo lunifrons Say. Cliff swallow. Common summer resident.
Hirundo bicolor Vieill. White-bellied swallow. Common summer resident.
Cotyle riparia Linn. Bank swallow. Common summer resident.
Progne purpurea Linn. Purple martin. Abundant. Summer resident. Have a curious habit of flocking together about the tallest buildings in towns, for a few days prior to departure, leaving for the South probably in the very early morning. One seen March 17, 1881.

AMPELIDÆ: Wax-wings.

Ampelis garrulus Linn. Northern wax-wing. Rare. Three specimens shot from a large flock, Dec. 6, 1879, by Prof. D. E. Lantz, a pair of which are now in the State University.
Ampelis cedrorum Vieill. Cedar bird. Not common; taken Dec. 4th.
Myiadestes Townsendii Aud. Townsend's fly-catching thrush. Rare; a single specimen taken.

VIREONIDÆ: Greenlets.

Vireo olivaceus Linn. Red-eyed vireo. Summer resident; common.
Vireo Bellii Aud. Bell's vireo. Common summer resident.
Vireo gilvus Vieill. Warbling vireo. On the authority of Prof. Popenoe.

LANIIDÆ: Shrikes.

Collyrio borealis Vieill. Butcher bird. One taken Jan. 16, 1879.
Collyrio Ludovicianus Linn. Loggerhead shrike. One taken March 15.

FRINGILLIDÆ: Finches and Sparrows.

Ægiothus linaria Linn. Red-poll linnet. One specimen, January, 1881.
Chrysomitris tristis Linn. Yellowbird. Common resident.
Plectrophanes nivalis Linn. Snow bunting. Irregular winter visitant.
Plectrophanes lapponicus Linn. Lapland longspur. Common in winter.
Plectrophanes ornatus Towns Chestnut-collared bunting.
Passerculus savanna Wils. Savanna sparrow. Migratory; common.
Poœcetes gramineus Gm. Grass finch; bay-winged bunting. One specimen taken about the middle of November, 1880.
Coturniculus passerinus Wils. Yellow-winged sparrow.
Melospiza Lincolni Aud. Lincoln's finch. Migratory; one taken in November, 1880.
Junco hyemalis Linn. Black snowbird. Winter resident; common.

Spizella monticola Gm. Tree sparrow. Abundant winter resident.

Spizella socialis Wils. Chipping sparrow. Common summer resident.

Spizella pallida Sw. Clay-colored sparrow. A single specimen taken.

Zonotrichia albicollis Gm. White-throated sparrow. Migratory; common.

Zonotrichia leucophrys Forst. White-crowned sparrow. Migratory; common.

Zonotrichia querula Nutt. Harris's sparrow. Migratory; common.

Passer domesticus L. English sparrow. First seen in spring of 1880. Resident.

Chondestes grammaca Say. Lark finch. Abundant in summer.

Passerella iliaca Sw. Fox sparrow.

Euspiza Americana Gm. Black-throated bunting. Abundant in summer.

Goniaphea cærulea Linn. Blue grosbeak. Common in summer.

Cyanospiza cyanea Linn. Indigo-bird. Common summer resident.

Cardinalis Virginianus Linn. Redbird. Resident; common.

Pipilo erythrophthalmus Linn. Chewink. Summer resident; common.

Pipilo maculatus Sw. var. *arcticus* Sw. Arctic towhee; spotted chewink. Rare migrant. One taken by Prof. E. A. Popenoe, October, 1880.

ICTERIDÆ: American Starlings; Blackbirds.

Dolichonyx oryzivorus Linn. Bobolink. Taken in spring.

Molothrus pecoris Gm. Cowbird. Abundant from early spring to late in fall.

Agelæus phœniceus Linn. Red-wing blackbird. Common summer resident.

Xanthocephalus icterocephalus Bp. Yellow-headed blackbird. Chiefly migratory. Abundant in spring of 1876, feeding on the Rocky Mountain locust. Seen also as late as July 4, 1878.

Sturnella magna Linn. Meadow lark. Summer resident; common. Seen also in sheltered places occasionally during winter.

Var. *neglecta* Aud. Western lark. Same remarks apply as to the above.

Icterus spurius Linn. Orchard oriole. Summer resident; abundant.

Icterus Baltimore Linn. Baltimore oriole. Summer resident; abundant.

Quiscalus purpureus Bart. Crow blackbird. Very abundant in summer, and in fall congregating in large flocks, and going miles to a common roosting place.

CORVIDÆ: Crows and Jays

Corvus Americanus Aud. Common crow. Resident; common.

Pica melanoleuca Vieill. Magpie. Several seen in midwinter, near Randolph, by Geo. Dougherty, and one in July, 1880, by myself, at Manhattan.

Cyanurus cristatus Linn. Blue Jay. Resident; abundant.

TYRANNIDÆ: American Fly-catchers.

Tyrannus Carolinensis Linn. Kingbird; Bee martin. Summer resident; abundant.

Myiarchus crinitus Linn. Great-crested fly-catcher. Common summer resident.

Sayornis fuscus Gm. Pewee; Phœbe-bird. Common summer resident.

Contopus virens Linn. Wood pewee. Migratory; not common. Taken in summer; probably breeds.

Empidonax obscurus Bd. Wright's fly-catcher. One specimen taken by myself, and identified by Prof. E. A. Popenoe.

CAPRIMULGIDÆ: Goat-suckers.

Antrostomus vociferus Wils. Whippoorwill. Rare.

Antrostomus Nuttallii Aud. Nuttall's whippoorwill. Common summer resident.

Chordeiles Virginianus Gm. Night hawk. Common summer resident.

CYPSELIDÆ: Swifts.

Chætura pelagia Linn. Chimney swallow. Summer resident; common.

TROCHILIDÆ: Humming Birds.

Trochilus colubris Linn. Ruby-throated humming-bird. Summer resident; common.

ALCEDINIDÆ: Kingfishers.

Ceryle alcyon Linn. Belted kingfisher. Summer resident; common.

CUCULIDÆ: Cuckoos.

Coccyzus Americanus Linn. Yellow-billed cuckoo. Summer resident; common.

PICIDÆ: Woodpeckers.

Hylotomus pileatus Linn. Black woodcock. Rare resident.

Picus villosus Linn. Hairy woodpecker. Resident; common.

Picus pubescens Linn. Downy woodpecker. Resident; common.

Centurus Carolinus Linn. Red-bellied woodpecker. Resident; common.

Melanerpes erythrocephalus Linn. Red-headed woodpecker. Summer resident; common.

Colaptes auratus Linn. Golden-winged woodpecker. Common resident.

Colaptes auratus var. *hybridus* Baird. Rare.

STRIGIDÆ: Owls.

Strix flammea Linn. Barn owl. One taken October 12, 1878, is now in the State University.

Bubo Virginianus Gm. Great horned owl. Resident; common.

Scops asio Linn. Screech owl. Resident; common.

Otus Wilsonianus Less. Long-eared owl.

Brachyotus palustris Bechst. Short-eared owl.

Syrnium nebulosum Forst. Barred owl. Common.

Nyctale acadica Gm. Saw-whet owl. Rare. Taken Feb. 8, 1879.

Speotyto cunicularia Mol. Burrowing owl. Once common, but not now found in Riley county.

FALCONIDÆ: Diurnal Birds of Prey.

Circus Hudsonius Linn. Marsh hawk. Resident; common.

Nauclerus furcatus Linn. Swallow-tailed kite. Rare. A handsome specimen, taken the first of September, 1880, had lost the beak to the upper end of the cere. This had healed perfectly when captured. The bird is now in my possession.

Accipiter fuscus Gm. Sharp-shinned hawk. Migratory; common.

Astur atricapillus Wils. Goshawk. A female that had just finished eating a rabbit was captured by W. F. Allen, in February, 1878. It is now in the cabinet of the State University.

Falco sacer Forst. var. *islandicus* Cass. Jer-falcon. One specimen taken, fall of 1880.

Falco communis Gm. Duck hawk. Rare. One specimen taken.

Falco columbarius Linn. Pigeon hawk. Taken in December 1878.

Falco sparverius Linn. Sparrow hawk. Resident; common.

Buteo Harlani Aud. Harlan's hawk. One specimen taken.

Buteo borealis Gm. Red-tailed hawk. Common; resident. A nest of three eggs was taken by Mr. Persons, from a tree on his land. The same birds nesting again, Prof. E. A. Popenoe and myself took the two eggs, which were nearly ready to hatch.

Buteo lineatus Gm. Red-shouldered hawk.

Archibuteo lagopus Brünn. var. *Sancti-Johannis* Gm. Rough-legged hawk. Taken Jan. 11.

Pandion haliaëtus Linn. Fish-hawk. A fine specimen taken by Geo. W. Harrop, Oct. 14th, 1880.

Aquila chrysaëtus Linn. Golden eagle. Not uncommon in winter.

Halitaëus leucocephalus Linn. Bald eagle. Resident; rare. A fine specimen was *not* captured when it swooped down upon a stuffed goose (*Branta Canadensis*), set out on a sandbar for a decoy. The pedestal on which the goose was mounted, being covered with sand, was quite heavy, so it only overturned when struck by the talons of the eagle. The eagle then alighted for a moment by the side of the decoy, and gave it a look of unutterable surprise and disgust which was only exceeded by my own, as he spread his noble pinions and sailed away out of my sight before I could bring my gun to bear on him.

CATHARTIDÆ: Vultures.

Cathartes aura Linn. Turkey buzzard. Common; resident.

COLUMBIDÆ: Doves.

Zenœdura Carolinensis Linn. Common dove. Summer resident; abundant. Also seen in sheltered places during the entire year.

MELEAGRIDIDÆ: Turkeys.

Meleagris gallopavo Linn. Wild turkey. Once common; now rare.

TETRAONIDÆ: Grouse; Quail.

Cupidonia cupido Linn. Prairie chicken. Resident; abundant.

Ortyx Virginianus Linn. Bob-white; quail. Resident; abundant.

CHARADRIIDÆ: Plovers.

Charadrius fulvus Gm. var. *Virginicus* Bork. Golden plover. Migratory.

Ægialitis vociferus Linn. Killdeer plover. Summer resident; abundant; seen as late as November 7, 1880.

Ægialitis semipalmatus Bp. Ring plover. One specimen.

RECURVIROSTRIDÆ: Avocets.

Recurvirostra Americana Gm. American avocet. Migratory; not common.

PHALAROPODIDÆ: Phalaropes.

Phalaropus Wilsoni Sab. Wilson's phalarope. Migratory; rare.

SCOLOPACIDÆ: Snipe, Curlew, etc.

Gallinago Wilsoni Temm. American snipe. Migratory; common.

Macrorhamphus griseus Gm. Red-breasted snipe. Migratory.

Macrorhamphus scolopaceus Say. Long-billed snipe. Migratory; rare.

Micropalama himantopus Bp. Stilted sandpiper. Migratory; rare.

Ereunetes pusillus Linn. Semipalmated sandpiper. Migratory; rare.

Tringa minutilla Vieill. Least sandpiper; migratory; abundant.

Tringa maculata Vieill. Jack-snipe; migratory; common.

Tringa Bonapartii Schl. White-rumped sandpiper; migratory; rare.

Totanus semipalmatus Gm. Willet. Migratory; common. Two specimens taken by Master John Elliott, June 1st, 1880.

Totanus melanoleucus Gm. Greater telltale. Migratory; common.

Totanus flavipes Gm. Yellow-legs. Migratory; abundant.

Totanus solitarius Wils. Solitary tattler. Not common; probably breeds; taken August 13.

Tringoides macularius Linn. Spotted sandpiper.

Actiturus Bartramius Wils. Field-plover. Summer resident; abundant.

Tryngites rufescens Vieill. Buff-breasted sandpiper. Migratory.

Numenius longirostris Wils. Long-billed curlew. Summer resident; not uncommon; taken June 17.

Numenius borealis Forst. Esquimaux curlew. Migratory.

ARDEIDÆ: Herons.

Ardea herodias Linn. Great blue heron. Summer resident; common. Four nests in one sycamore tree were a great temptation to me, but I could not reach them.

Ardea egretta Gm. White heron. Probably breeds, as a family were seen, of which one old one and one half grown were captured by Rev. A. B. Campbell, about the 1st of August, 1880.

Ardea virescens Linn. Green heron. Summer resident; common.

Botaurus minor Gm. Bittern; stakedriver. Summer resident; common.

Ardetta exilis Gm. Least bittern. Rare.

GRUIDÆ: Cranes.

Grus Americanus Linn. White or whooping crane. Migratory; rare.

Grus Canadensis Linn. Sandhill crane. Migratory; common. Passes north about the middle of April. From a flock of four, two were shot, April 15th, one of which showed a good many white feathers on the thighs, and some on the neck.

RALLIDÆ: Rails.

Rallus elegans Aud. King rail. Rare. A nest of eight eggs and the female were taken in May, 1880. The male was seen several days later in the same place, but was not captured.

Porzana carolina Linn. Common rail. Migratory.

Porzana Jamaicensis Gm. Little black rail. Rare. Two taken, one on Sept. 4, 1878, and one in June of 1880. Also, at same date and place as the last, a nest of eight eggs that had been washed out by high water.

Fulica Americana Gm. Coot; mud hen. Abundant; migratory. Probably breeds.

ANATIDÆ: Swans, Geese, and Ducks.

Cygnus buccinator Rich. Trumpeter swan. Migratory; rare; passes north about the 1st of March.

Anser albifrons Gm. var. *Gambeli* Hart. Laughing goose. Two specimens taken.

Anser hyperboreus Pall. Snow goose. Migratory; common.

Branta Canadensis Linn. Canada goose. Migratory; abundant in migration, and a rare winter resident.

Branta Hutchinsii Sw. Hutchins's goose. Migratory; not common.

Anas boschas Linn. Mallard duck. Migratory; abundant.

Dafila acuta Linn. Pintail duck. Migratory; common.

Chaulelasmus streperus Linn. Gadwall; grey duck. Migratory; common.

Mareca Americana Gm. American widgeon. Migratory; common.

Querquedula Carolinensis Gm. Green-winged teal. Migratory; abundant.

Querquedula discors Linn. Blue-winged teal. Migratory; common.

Spautla clypeata Linn Shoveler; spoon-bill Migratory.

Aix sponsa Linn. Summer duck. Summer resident.

Fuligula affinis Eyt. Little black-head. Common. A specimen taken with a white feather in one wing.

Fuligula collaris Donov. Ring-necked duck. Migratory.

Aythya Americana Eyton. Red-head duck. Migratory; common.

Aythya vallisneria Wils. Canvas-back duck. Migratory; common.

Bucephala clangula Linn. Golden-eyed duck. Migratory; rare; winter resident. Two taken about the 1st of December, by Dan. Casement.

Bucephala albeola Linn. Butterball. Migratory; common.

Erismatura rubida Wils. Ruddy duck. Migratory; rare.
Mergus Merganser Linn. Merganser; goosander. Migratory.
Mergus serrator Linn. Red-breasted merganser. Migratory.
Mergus cucullatus Linn. Hooded merganser. Migratory.

PELECANIDÆ: Pelicans.

Pelecanus erythrorhynchus Gm. American pelican. Migratory; common. Pass north about the 10th of April, in large flocks. One female was taken that had eggs developed to the size of one inch in diameter. The bill of this specimen bore a well-developed "button."

PHALACROCORACIDÆ: Cormorants.

Graculus dilophus Sw. Double-crested cormorant. Migratory; rare.

LARIDÆ: Terns.

Hydrochelidon lariformis Linn. Black tern; short-tailed tern. Migratory; rare. Taken May 13, 1878.

COLYMBIDÆ: Loons.

Colymbus torquatus Brünn. Loon. One immature specimen taken.

PODICIPIDÆ: Grebes.

Podiceps auritus Linn. var *Californicus* Heerm. American eared grebe. Migratory; rare. One taken Sept. 30, 1878, is now in the Smithsonian Institution.

Podilymbus podiceps Linn. Pied-billed Grebe; dabchick. Migratory.

The following are resident:

Robin.
Black-capped tit.
White-bellied nuthatch.
American goldfinch.
English sparrow.
Redbird.
Meadow lark.
Western lark.
Crow.
Blue jay.
Black woodcock.
Hairy woodpecker.
Downy woodpecker.
Red-bellied woodpecker.
Golden-winged woodpecker.
Great horned owl.
Barred owl.
Marsh hawk.
Red-tailed hawk.
Bald eagle.
Turkey buzzard.
Dove.
Turkey.
Prairie chicken.
Quail—25.

List of species that breed in this county. Those marked with a * have been taken in the breeding season, but are not positively known to breed.

Robin.
Wood thrush.
Mocking bird.
Catbird.
Brown thrush.
Bluebird.
House wren.
Horned lark.
Yellow warbler.
Kentucky warbler.*
Maryland yellow-throat.*
Yellow-breasted chat.
Redstart.*
Scarlet tanager.
Cliff swallow.
White-bellied swallow.
Bank swallow.
Purple martin.
Red-eyed vireo.
Bell's vireo.
Yellow bird.
Yellow-winged sparrow.
Chipping sparrow.
English sparrow.

Lark finch.
Black-throated bunting.
Blue grosbeak.
Indigo bird.
Redbird.
Chewink.
Cowbird.
Red-winged blackbird.
Meadow lark.
Western lark.
Orchard oriole.
Baltimore oriole.
Crow blackbird.
Crow.
Blue jay.
King-bird.
Great-crested flycatcher.*
Wood pewee.*
Whippoorwill.*
Nuttall's whippoorwill.*
Night hawk.
Chimney swallow.
Humming bird.
Kingfisher.
Yellow-billed cuckoo.
Black woodcock.
Hairy woodpecker.
Downy woodpecker.
Red-bellied woodpecker.
Red-headed woodpecker.
Golden-winged woodpecker.
Great horned owl.
Screech owl.*
Barred owl.
Marsh hawk.
Sparrow hawk.
Red-tailed hawk.
Bald eagle.
Turkey buzzard.
Carolina dove.
Prairie chicken.
Turkey.
Quail.
Killdeer plover.
Field plover.
Solitary tattler.*
Long-billed curlew.
Great blue heron.
White heron.*
Green heron.
Bittern.
King rail.
Little black rail.
Coot.
Wood duck.
Hooded merganser (?)*—80.

List of winter residents only. Those marked with a * are rare.

Northern waxwing.*
Butcher bird.*
Lapland longspur.
Black snow-bird.
Golden eagle.
Tree sparrow.
Harris's sparrow.—7.

A PRELIMINARY CATALOGUE OF KANSAS REPTILES AND BATRACHIANS.

BY F. W. CRAGIN, CAMBRIDGE, MASS.

The object of this catalogue is to give a condensed view of the present state of our knowledge concerning the herpetological fauna of Kansas. As this object would not otherwise be fully accomplished, I incorporate in the list of reptiles and batrachians already observed in the State, the names of such others as cannot reasonably be doubted to occur there; and append to this a supplementary list, comprising the names of species whose future identification in Kansas there is more or less reason to anticipate, giving with each name the principal evidence upon which it is included.

Among those who have kindly assisted me in the preparation of this catalogue, I am most indebted to Prof. E. A. Popenoe, of the Kansas State Agricultural College, whose warm and constant interest in my work has been shown in a most practical manner by the sending of many notes and specimens. Acknowledgments are also due to Prof. F. H. Snow, of the

Kansas State University, for the use of undetermined material in the museum of that institution, and for several interesting notes; to Prof. E. D. Cope, for the determination of difficult species and for other favors; through Prof. S. F. Baird, to Mr. S. C. Brown, of the Smithsonian Institution, for a list of the Kansas reptiles and batrachians in the National Museum; to J. S. Nolan, of the Philadelphia Academy of Natural Science, for a similar list, drawn up from the collection of said Academy; through Mr. J. A. Allen, to Mr. S. Garman, of the Cambridge Museum of Comparative Zoölogy, for a similar list of specimens under his charge, as well as for other favors; to Prof. William Wheeler, of Ottawa, for notes on the tortoises, etc., of the Osage river at that point; to Mr. Harvey Worrall, of Topeka, for the names of specimens in the collection at the State House; and to Col. N. S. Goss, of Neosho Falls.

Of the published writings which I have found useful in the study of Kansas herpetology, the most important are, Cope's "Check-list of North American Batrachia and Reptelia," (the classification and nomenclature in which are followed in the present paper;) Dr. Hallowell's writings in Proc. Phila. Acad. Nat. Sci., 1856, pp. 238 and 309; Miss A. E. Mozley's "List of Kansas Snakes in the Museum of the Kansas State University," (Transac. Kan. Acad. Sci., VI;) Agassiz's "Contributions to the Natural History of the United States," I; and Jordan's "Manual of the Vertebrates."

TESTUDINATA.

EMYDIDÆ.

Cistudo ornata Agass.: Western Box-tortoise. Appears to be rather common at Manhattan, and westward throughout the State. Its eastern limit has not been definitely ascertained. I have observed *Cistudo* common at Topeka, but whether of the *ornata* or *clausa* type, I am unable to state. A young specimen of *ornata*, taken at Manhattan, by Prof. Popenoe, shows a slight approach to *clausa*, in having a partially developed keel.

Cistudo clausa Gm.: Box-tortoise. Prof. Wheeler writes me that he has observed this species at Ottawa. This is doubtless nearly the western limit of its distribution.

Cistudo clausa Gm., var. *triunguis* Ag.: Three-toed Box-tortoise. A single specimen, observed by Prof. Popenoe, at Manhattan. Osage river (Agassiz).

Chrysemys oregonensis Harl.: Golden Tortoise. The range of this species is given by authors as extending over nearly the entire region west of the Mississippi and east of the Pacific slopes.

Chrysemys picta Herm.: Painted Tortoise. An Eastern species, but doubtless ascending the Missouri and its tributaries well into the State. Under the name of *C. Bellii*, Agassiz has accorded its abundance in western Missouri. Prof. Popenoe writes me that he has observed in the Kansas river a tortoise which he believes to be of this species, but not having obtained a specimen, is not quite sure.

Malacoclemmys pseudogeographicus Holb.: Le Sueur's Map-tortoise. Five specimens of this tortoise, included in Dr. Hammond's Kansas and Nebraska collection (Hallowell) were probably taken at or near Fort Riley, as were most of the specimens in this collection. Osage river (Agassiz).

Malacoclemmys geographicus Le Sueur: Map-tortoise. Prof. Wheeler, writing from Ottawa, states that he has observed the *geographicus* at that locality. I believe this observation somewhat extends its known westward range.

Pseudemys elegans Wied.: Elegant Terrapin. Osage river, and from the upper Missouri to Texas (Agassiz). Illinois to the Rocky Mountains (Jordan).

CINOSTERNIDÆ.

Aromochelys carinatus Gray: Southern Musk-tortoise. Under the name of *Ozotheca tristycha*, Agassiz gives this species as common in the Osage river.

CHELYDRIDÆ.

Chelydra serpentina Linn.: Snapping-tortoise. Reported from Ottawa by Prof. Wheeler, and from Lawrence by Prof. Snow. Ranges over the entire region east of the Sierra Nevada and south of British America to Ecuador. (Cope.)

TRIONYCHIDÆ.

Aspidonectes spinifer Le Sueur: Soft-shelled Tortoise. Prof. Popenoe writes me that he has taken three specimens of this tortoise at the mouth of the Blue river. Prof. Wheeler also reports it from Ottawa, and Prof. Snow from Lawrence. Authors mention it as common in most of the tributaries of the Missouri.

Amyda mutica Le Sueur: Leathery Tortoise. This species is not uncommon in the vicinity of Manhattan, where Prof. Popenoe has observed it in the Blue and Kansas rivers.

LACERTILIA.

IGUANIDÆ.

Phrynosoma douglassii Bell: Horned Lizard. Three specimens taken at Fort Riley, by Dr. Hammond (Hallowell). Prof. Snow informs me that he has taken *douglassii* in Douglas county, and knows of its having been taken in Doniphan county. Specimens from Kansas are in the National Museum (Brown), and in the collection of the Philadelphia Academy (Nolan).

Phrynosoma cornutum Harl.: Texan Horned Lizard. This appears to be, generally, the commoner *Phrynosoma* of Kansas. It occurs at least as far east as Ottawa, where it has been taken by Prof. Wheeler. Four specimens sent from Manhattan, by Prof. Popenoe, vary considerably in color, and have the inferior surface of the body marked with sparse black spots, but offer no arked peculiarities. The ovaries of one of these specimens contained seven-en eggs, averaging fifty-five hundredths of an inch in length by thirty-five diameter.

Sceloporus consobrinus B. & G. A Sonoran and Central species, ranging to the north, south and west of Kansas, and doubtless over the western part of the State. Sand-hills, valley of the Platte (Hayden). Canadian fork (Baird).

Sceloporus undulatus Harl.: Tree Lizard. I have seen a single specimen of this lizard, taken in Rooks county, or vicinity, by Prof. Popenoe. Ft. Riley (Brown).

Crotaphytus collaris Say: Black-shouldered Lizard. Occurs throughout the State. Prof. Popenoe writes: "Rather frequent about Manhattan. Inhabits stone-quarries and rocky hills. Very agile and somewhat difficult to capture. Fights when taken."

Holbrookia maculata Gir.: Cactus Lizard. Neosho river (Brown, Goss) and westward. Prof. Popenoe, who has observed the species in middle and western Kansas, writes that it is found on dry, hot, sandy or stony plains and hillsides, dodging about clumps of grass or cactus, when pursued, and keeping on the side opposite its pursuer, but never assuming the defensive when caught. He further states that it varies considerably in shade.

ANGUIDÆ.

Opheosaurus ventralis Daud.: "Glass Snake." Well known in many parts of Kansas as the "joint snake." As it is rarely seen except when turned up by the plow, it is nowhere regarded as abundant. Prof. Popenoe writes that he has observed it several times at Topeka, and Prof. Wheeler sends a similar note for Ottawa; Prof. Snow reports it as not uncommon at Lawrence; it is represented in the collection of the Philadelphia Academy, from Republican fork; and I have observed a single specimen in Crawford county. It occurs westward to Bridger's Pass (Hallowell).

TEIDÆ.

Cnemidophorus sexlineatus Linn.: Six-lined Swift. A southern species, extending northward to the Platte (Hayden). One specimen was taken by Dr. Hammond, at Ft. Riley (Hallowell), and seven others, collected by him in "Kansas and Nebraska" (Hallowell), were probably taken near the same point. A specimen taken in or near Rooks county, by Prof. Popenoe, differs somewhat from eastern specimens in having the anterior portions of the body suffused with a blue-green shade, deepest on the sides of the head, and passing insensibly into olive-gray posteriorly. Dr. Coues considers this lizard the most agile of all its tribe, and states that it is emphatically a ground lizard—not a tree or rock species.

SCINCIDÆ.

Eumeces fasciatus, Linn.: Blue-tailed Skink. Prof. Popenoe, who has observed this species in Shawnee county, writes that it is common in the woods along Indian creek, preferring damp, shady localities. Taken at Fort Riley by Dr. Hammond (Nolan), and at Lawrence by Prof. Snow.

Eumeces Guttulatus Hallow.: Black Skink. I have received one specimen

of this handsome little lizard from Manhattan, through Prof. Popenoe. It is also represented from Kansas in the collection of the Philadelphia Academy (Nolan), and is doubtfully recorded from the upper Arkansas by Baird.

Eumeces obsoletus B. & G. Specimens from Douglas county, where the species seems to be common, exhibit marked variations in color and in the arrangement of the anterior cephalic plates. (See Bulletin 20, U. S. Nat. Mus., p. 39.)

Eumeces septentrionalis Bd.: Northern Skink. A single specimen from Neosho Falls is in the National Museum (Brown).

Oligosoma laterale Say.: Ground Lizard. Prof. Popenoe writes that it is not rare at Topeka, occurring with *E. fasciatus*. A specimen from that locality, for which I am indebted to him, has the scales in twenty-eight rows. There is a specimen from Fort Scott in the National Museum (Brown).

OPHIDIA.

COLUBRIDÆ.

Heterodon simus Linn., var. *nasicus* B. & G. Fort Riley (Brown), Ft. Hays (German), Wallace county (Mozley). A specimen collected by Prof. Popenoe in Phillips county, is in the State House collection. Snakes of this genus are popularly known in Kansas under the name of "blow snakes."

Heterodon simus Linn. Wallace county (Mozley), Ft. Riley (Nolan)

Heterodon platyrhinus Latr., var. *atmodes* B. & G. Douglas county (Mozley).

Heterodon platyrhinus Latr.: Hog-nose. Three specimens in National Museum from Ft, Riley (Brown), Douglas county (Mozley). A specimen taken by Prof. Popenoe in Rooks county, is in the collection at the State House.

Tropidonotus rhombifer Hallow.: Holbrook's Water Snake. Douglas county (Snow).

Tropidonotus sipedon Linn., var. *erythrogaster* Shaw: Copper-belly. Kansas (Cope).

Tropidonotus sipedon Linn.: Water Snake. Douglas county (Mozley), Ft. Riley (Brown). Fifty miles northwest of Ft. Riley (Nolan). The collection at the State House includes a specimen from Saline county.

Tropidonotus grahamii B. & G.: Graham's Snake. Taken in Douglas county (Snow).

Tropidoclonium lineatum Hallow. This species, first described by Hallowell in 1856, was based on a specimen taken in Kansas by Dr. Hammond Two specimens, taken in Douglas county, are in the museum of the State. University (Snow); and another, from Neosho Falls, is in the National Museum (Brown).

Storeria dekayi Holbr.: De Kay's Brown Snake. Taken in Douglas county (Snow). One specimen in the National Museum, from Kansas (Brown).

Storeria occipitomaculata Stover: Spot-necked Snake. Taken in Douglas county (Snow). Taken in Kansas by Dr. Hammond (Nolan).

Eutœnia sirtalis Linn., var. *parietalis* Say: Parietal Garter Snake. Taken at Manhattan and at Topeka by Prof. Popenoe. Ft. Riley (Nolan). Douglas county (Snow, Mozley). Prof. Popenoe mentions this as one of the commoner species in his experience, and writes that it takes to the water as readily as *tropidonotus*.

Eutœnia sirtalis Linn., var. *ordinoides* B. & G. Taken in Kansas by Dr. Hammond (Nolan).

Eutœnia sirtalis Linn., var. *ordinata* Linn.: Grass Snake. Taken in Kansas by Dr. Hammond (Nolan).

Eutœnia sirtalis Linn.: Common Garter Snake. One specimen in National Museum from Ft. Riley, and one from Neosho Falls (Brown). Douglas county (Mozley). Prof. Popenoe notes this species as about equally abundant with var. *parietalis*.

Eutœnia sirtalis Linn., var. *dorsalis* B. & G. Douglas county (Mozley).

Eutœnia vagrans B. & G.: Wandering Garter Snake. Ft. Riley (Nolan). In Cambridge Museum of Comparative Zoölogy, from Kansas (Garman).

Eutœnia marciana B. & G.: Marcy's Garter Snake. Ft. Hays (Garman). Douglas county (Mozley).

Eutœnia radix B. & G., var. *haydeni* Kenn.: Hayden's Garter Snake. Wallace (Snow). Manhattan? (Popenoe).

Eutœnia radix Say: Say's Garter Snake. On the authority of Prof. Popenoe, I give this species as common. Specimens are recorded from eastern, middle, and western Kansas.

Eutœnia fareyi B. & G.: Fairie's Ribbon Snake. One specimen in National Museum, from Neosho Falls (Brown).

Eutœnia saurita Linn.: Ribbon Snake. Douglas county (Mozley).

Bascaniun constrictor Linn.: Black Snake. Common in Crawford county, and not rare in Shawnee. Ft. Riley (Hallowell).

Bascaniun constrictor Linn., var. *flaviventre* B. & G.: Blue Racer. Common in Crawford and Shawnee counties. A specimen in the State House collection, from Clay Center. Prof. Popenoe writes that, next to the *Oph. doliatus triangulus*, this is the most abundant species.

Pituoplus sayi Schleg.: Say's Bull Snake. Ft. Riley (Garman). Douglas county (Mozley.) In the State House collection, from Rooks county. Prof. Wheeler, writing from Ottawa, informs me that he has a specimen of this bull snake eight feet in length, and that it occurs there considerably larger.

Pituophis sayi Schleg., var. *mexicanus* Dum. & Bibr.: Mexican Bull Snake. One specimen in the National Museum, from Ft. Riley (Brown).

Coluber obsoletus Say: Pilot Snake. Ft. Riley (Brown). Douglas county (Mozley, Snow). Ottawa—growing to a length of ninety inches (Wheeler).

Coluber obsoletus Say., var. *confinis* B. & G.: Douglas county (Snow). Ft. Riley (Hallowell).

Coluber vulpinus B. & G.: Fox Snake. Kansas (Cope).

Coluber emoryi B. & G.: Emory's Racer. Ft. Riley (Brown). A Man-

hattan specimen, loaned me by Prof. Popenoe, has the dorsal scales in twenty-seven rows, and the labials mostly dark-edged, the seventh largest, both above and below. A dark spot enters the orbit on the fourth labial, and extends backward to the sixth. The abdominal blotches show a considerable degree of regularity, being arranged in four rows, one of gray blotches on each side, usually occupying the extremities of alternate scutellæ, and just within each of these another of considerably darker blotches. The inner and outer of these rows, on either side, are strictly complementary, not a single blotch of either lying on the same scutella with one of the row adjacent. On the tail, the blotches of the two outer rows are gradually lost, while those of the two inner approximate, till, on the posterior half, they occupy adjacent scutellæ, and form two nearly continuous black bands.

Cyclophus vernalis DeKay.: Northern Green Snake. An eastern and northern species, occurring westward to Colorado (Coues and Yarrow). Ft. Riley (Nolan). "Neosho" (Brown).

Diadophis punctatus Linn.: Ring-necked Snake. Douglas county (Mozley).

Diadophis punctatus Linn., var. *amabilis* B. & G.: Central and Eastern regions as far as Ohio (Cope).

Diadophis punctatus Linn., var. *docilis* B. & G.: Two specimens of *punctatus* received from Prof. Popenoe, and collected by him at Topeka, represent this sub-species, but with the dorsal scales in seventeen rows.

Diadophis arnyi Kenn. One specimen in the National Museum, from "Hyette, Kan." (Brown).

Ophibolus calligaster Say: Kennicott's Chain Snake. Ft. Riley (Hallowell). Douglas county (Mozley). Neosho Falls (Brown).

Ophibolus getulus Linn., var. *sayi* Holb.: King Snake. Douglas county (Mozley). Shawnee Mission and Ft. Riley (Brown). A Topeka specimen is in the State House collection.

Ophibolus doliatus Linn., var. *triangulus* Boie.: Milk Snake. Prof. Popenoe writes me that this is the most abundant serpent in the State, and very variable.

Ophibolus doliatus Linn.: Corn Snake. Three Douglas county specimens in the museum of the Kansas State University (Snow). Topeka and Manhattan (Popenoe). The National Museum and Philadelphia Academy both have specimens from Kansas.

Ophibolus doliatus Linn., var. *annulutas* Kenn. Kansas (Cope).

Ophibolus doliatus Linn., var. *gentilis* B. & G. Wallace county (Mozley). A specimen labeled "*Ophibolus Gentilis??*" taken by Prof. Popenoe, at Topeka, is in the State House collection.

Ophibolus doliatus Linn., var. *coccineus* Schleg. Kansas (Cope).

Tantilla nigriceps Kenn. A single specimen in National Museum, from Ft. Riley (Brown).

Carphophiops vermis Kenn.: Worm Snake. Ft. Scott (Brown). Douglas county (Mozley).

CROTALIDÆ.

Ancistrodon contortrix Linn.: Copperhead. Prof. Popenoe writes from Manhattan that the copperhead is neither rare nor common at that point. A small specimen which he sends is rather darker than is the rule with eastern specimens. Douglas county (Mozley).

Caudisona tergermina Say: Massasauga. Douglas county (Mozley). Near Ft. Riley (Nolan).

Caudisona Edwardsii B. & G. Topeka, one specimen (Popenoe).

Crotalus confluentus Say: Missouri Rattlesnake. Two Rooks county specimens are in the collection at the State House. Ft. Hays (Garman). Osborne City (Mozley). Ft. Riley (Nolan). Wallace county (Snow).

Crotalus horridus Linn.: Banded Rattlesnake. Douglas county (Snow). One specimen from Kansas in National Museum (Brown).

ANURA.

RANIDÆ.

Rana catesbiana Shaw: Bull Frog. Prof. Popenoe writes: "Topeka and Manhattan; rather common; inhabits only deeper streams."

Rana halecina Kalm.: Leopard Frog. Of this species Prof. Popenoe writes again: "Abundantt found on the margins of all water."

HYLIDÆ.

Hyla versicolor Le Conte: Northern Tree Frog. In Cambridge Museum of Comparative Zoölogy, from Kansas (Garman).

Chorophilus triseriatus Wied.: Striped Bush Frog. One of the most abundant batrachians of Kansas. Prof. Popenoe writes: "I have never captured them on trees, but frequently in roadside puddles." Mr. Garman tells me that they often crawl upon bushes two or three feet above the water. They vary greatly both in color and in the pattern of their markings. The ovaries of a specimen sent me by Prof. Popenoe contained about four hundred and twenty eggs, and the stomach was distended with a large grub, the head, thorax, and elytra of a species of *Aphodius*, a small spider and a quantity of apparently silicious matter.

Acris gryllus Le Conte., var. *crepitaus* Bd.: Cricket Frog. One hundred and fifty miles west of Ft. Riley (Brown). Ft. Riley (Nolan).

ENGYSTOMIDÆ.

Engystoma carolinense Holb. Kansas (Hallow.).

BUFONIDÆ.

Bufo lentiginosus Shaw., var. *fowlerii* Putnam: Fowler's Toad. Manhattan and E. (Popenoe).

Bufo lentiginosus Shaw., var. *americanus* Le Conte: Common Toad. Common at Manhattan and westward (Popenoe). Should be found also eastward.

Bufo lentiginosus Shaw., var. *cognatus* Say. Two Kansas specimens, one

of them from Ft. Riley, are in the National Museum (Brown). A third is in the collection of the Boston Natural History Society (Henshaw).

Bufo lentiginosus Shaw., var. *frontosus* Cope. Kansas (Brown).

URODELA.

PLETHODONTIDÆ.

Spelerpes ruber Daud.: Red Salamander. Maine to Nebraska and southward (Jordan).

AMBLYSTOMIDÆ.

Amblystoma microstomum Cope: Small-mouthed Salamander. Kansas (Jordan).

Amblystoma mavortium Bd.: Prairie Salamander. Ft. Riley (Cope). Douglas county (Snow).

Amblystoma tigrinum Green.: Tiger Salamander. Two specimens, received from Manhattan, through Prof. Popenoe, have very short tails—nearly an inch shorter than from snout to behind anus; but as the specimens are small, this shortness may be due to their age. The larger specimen, 5.85 in. in length, has the tail .95 in. shorter than head and body; the smaller, 4.35 in. in length, has it shorter by very nearly the same. The stomach of the larger of these specimens contained two medium-sized grasshoppers, nearly intact.

Amblystoma punctatum Linn.: Violet Salamander. United States east of the Rocky Mountains (Jordan).

SUPPLEMENTARY LIST.

(Comprising species now known only as extralimital, but more or less likely to be found in Kansas.)

Pseudemys troostii Holbr.: Yellow-bellied Terrapin. Osage river, Missouri (Agass.).

Pseudemys concinna Le Conte: Florida Terrapin. Southwestern Missouri (Agass.).

Cinosternum pennsylvanicum Bosc.: Mud Tortoise. Austroriparian and eastern region (Cope).

Aromochelys odoratus Latr.: Musk Tortoise. "Have seen specimens from western Missouri" (Agass.).

Maucrochelys lacertina Schweig.: Mississippi Snapper. Florida to Texas, and to Missouri in Mississippi (Cope).

Phrynosoma modestum Gir. Albuquerque, N. M., and near Canadian river (Baird).

Eumeces epipleurotus Cope. Ft. Kearney, Neb., and northern boundary of Texas (Cope).

Eumeces leptogrammus Bd. Sand-hills, valley of the Platte (Hayden). Central region (Cope).

Eumeces multivirgatus Hallow. Sand-hills, valley of the Platte (Hayden). Central region (Cope).

Eumeces inornatus Bd. Sand-hills, valley of the Platte (Hayden).

Tropidonotus sipedon Linn., var. *woodhousei* B. & G. Texas to Missouri (Cope).

Eutœnia sirtalis Linn., var. *pickeringii* B. & G. Pacific region, Minnesota, Texas (Cope).

Cyclophis œstivus Linn.: Southern Green Snake. New Mexico, Texas and western Missouri (Coues & Yarrow). Ft. Smith, Ark., (Baird).

Ophibolus multistratus Kenn. Nebraska (Cope).

Carphophiops amœnus Say.: Ground Snake. Western Missouri (Cooper).

Caudisona miliaria Linn.: Ft. Smith, Ark., (Bd).

Crotalus adamanteus Beauv., var. *atrox* B. & G. Indian Territory and Texas (Cope).

Rana clamatans Merrem.: Green Frog. Ft. Scott, Ark., (Baird.).

Spea bombifrons Cope. Central regions (Cope).

Amblystoma obscurum Baird. Iowa (Cope).

Amblystoma opacum Graveuk.: Banded Salamander. An eastern species, westward to Wisconsin and Texas (Cope).

Menopoma allegheniense Harl.: Hellbender. All tributaries of the Mississippi (Cope).

Necturus lateralis Say.: Mud Puppy. Eastern region except New England and eastern Middle States (Cope). Ft. Smith, Ark., (Baird).

BOTANICAL ADDENDA FOR 1879 AND 1880.

REPORTED BY J. H. CARRUTH.

In my report for 1876 are a few errors which I wish to correct:

Buchnera elongata is not a distinct species, but a synonym of *B. Americana.*

Physalis viscosa is perennial; and *P. pubescens,* annual.

Betula lenta should be *B. nigra* Ait. Red birch.

A *Sabbatia* between *S. gracilis* and *S. stellaris* proves to be *S. campestris.*

Carex alveoluteus should be *C. albolutescens.*

In the report for 1877 and 1878 *Gonolobus obliquus* should be *G. lœvis* or *macrophyllus* Mx.

In 1879 I tramped three or four months in Miami, Linn, Cherokee, and Labette counties, returning through the second tier. In giving the results of my observations there or elsewhere, I shall refer to the counties. When I do not recollect, I shall put S. E. K. for southeastern Kansas. In reporting plants sent by others I shall give their residences. When I have not seen the plants, I shall give the names of those reporting them.

Mr. J. Henry of Salina and Mr. B. B. Smyth of Great Bend have furnished some plants, and the names of others. I have found some not hitherto reported among plants collected by Prof. Snow in W. Kansas. Mrs. Jewell of Irving has given me a pretty full list of the plants of Marshall county.

Two young men of Miami county, Dr. J. H. Oyster of Paola and Mr. H. Hutchinson of Fontana, are studying thoroughly the botany of that county. Mr. M. H. Panton of Junction City, now of Clay Center, has studied pretty thoroughly the botany of Davis county, and given me the result of his observations.

E. N. Plank, Esq., of Independence, Montgomery Co., has become well acquainted with the plants of that county, and has contributed largely to the present addenda.

Miss E. F. Randolph of Pardee, Atchison county, has given me a few names.

Mrs. Jewell has given considerable time to the Fungi of Kansas, and sent me the names of the genera, so far as known.

In giving names of species not in any books within my reach, and in determining specimens unavoidably imperfect, I have been aided by Mr. E. Hall of Athens, Ills., and by Prof. Alphonso Wood of New York city, whose labors as an explorer and a teacher of botany have just been brought to a close. I feel his departure as a personal loss. I believe Prof. W. was the first to prepare for students a Botany arranged on the Natural System. His synopses of the larger genera gave his work a value beyond any other that I have known.

I have carefully compared the cultivated Jerusalem artichoke, *Helianthus tuberosus*, with the wild *Helianthus doronicoides*, and found no difference, except that I found the tubers of the latter very small. When I first saw the latter in Kansas, I thought it was the former, and was disappointed in not finding tubers. I have not always found them the past year.

I mark with a star (*) plants introduced, and with a cross (†) plants not found east of the Mississippi. I omit the names of the orders.

1149. Anemone Virginiana L. Miami, Linn, Cherokee; Independence, Plank.
1150. A. thalictroides L. (Thalictrum anemoides Mx.) Paola; Ind., Plank.
1151. Ranunculus rhomboideus Goldie. Ind., Plank.
1152. R. pusillus Poir. Labette.
1153. Cocculus Carolinianus DC. Lab., two varieties, one larger and earlier. Ind., Plank.
1154. Calycocarpum Lyoni Nutt. Cher.; Ind., Plank.
1155. Berberis, sp. uncertain. Reported to the Horticultural Society as native in Anderson county.
1156. Brasenia peltata Schroeb. Cher.
1157. Nymphea odorata L. Franklin, Linn, Lab.; Pardee, Miss Randolph.
1158. Nasturtium officinale R. Br. Douglas; Junction City, Panton.
1159. Gynandropsis pentaphylla DC. Seen in Atchison by Mrs. Jewell.

1160. Viola rotundifolia Mx. Pardee, Miss Randolph; Ind., Plank.
1161. V. Canadense L. Pardee, Miss R.
1162. V. pedata L. Lab.; Ind., Plank.
1163. V. arvensis DC. Cher., Lab.
1164. † Ionidium lineare Torr. From Irving. Not quite sure.
1165. Lechea major Mx. Cher.
1166. Hypericum sphærocarpon Mx. Miami.
1167. H. sarothra Mx. Lab.; Ind., Plank.
1168. H. Canadense L. Cher.
1169. H. gymnanthemum, var. Canadense. Salina, Henry. Same as the preceding?
1170. H. Drummondii T. & G. Lab.; Ind., Plank.
1171. * Saponaria officinalis L. Many places.
1172. Alsine brevifolia Nutt. Cher.
1173. Paronychia dichotoma Nutt. Great Bend, Smyth.
1174. * Portulaca oleracea L. Gardens.
1175. † P. pilosa. Miami; Ind., Plank.
1176. † P. retusa Eng. Ind., Plank.
1177. Talinum teretifolium L. Miami.
1178. † T. calycinum Eng. Sal., Henry. Has 50 or 60 stamens.
1179. † Malvastrum pedatifidum. G. B., Smyth.
1180. Hibiscus Carolinianus Muhl. Lab. Rare.
1181. Linum Virginianum L. Ind., Plank.
1182. * Ailanthus glandulosa Des F. Streets.
1183. Rhus venenata DC. Ind., Plank.
1184. Sapindus marginatus Willd. Soapberry. Sent from Barbour county.
1185. Euonymus Americanus L. Strawberry tree. Ind., Plank.
1186. Polygala polygama Walt. Paola.
1187. P. Senega L. Seneca snake-root. From Mr. W. A. Burnett, Decatur county.
1188. † Lathyrus ornatus Nutt. J. City.
1189. L. palustris L. Irv., Mrs. J.
1190. † Vicia truncata Nutt. J. City.
1191. Stylosanthes elatior Swartz. Ind., Plank.
1191. " " var. minimus Wood. Leaflets very small.
1192. Desmodium pauciflorum DC. Ind., Plank.
1193. D. Dillenii Darl. Cher.; Irv., Mrs. J.
1194. D. rigidum DC. Irv., Mrs. J.
1195. D. ciliare DC. Cher.
1196. Lespedeza capitata Mx. Typical form, leaves smooth above. Leaves here usually silky both sides. Linn.
1197. L. hirta Ell. Cher.
1198. * Trifolium pratense L. Fields.
1199. * Medicago sativa L. Alfalfa. Streets, Topeka; G. B., Smyth.
1200. Psoralea melilotoides Mx. Lab.
1201. † P. hypogæa Nutt. J. City, Panton.
1202. † P. eglandulosa Ell. S. E. K.
1203. † P. scabra Nutt. J. City.
1204. Astragalus distortus T. & G. Fontana.
1205. † A. goniatus Nutt. S. E. K.
1206. † A microlobus Gr. Sal., Henry.
1207. † A. Plattensis Nutt. J. City.
1208. † A. campestris Nutt. From Rice Co., Dr. Oyster.

1209. † A adsurgens Pall. From W. Kansas, Dr. O.
1210. * Robinia hispida, L. Cultivated.
1211. Phaseolus helvolus L. Ind., Plank.
1212. Prunus maritima Wanz. Ind., Plank.
1213. Cratægus punctata Ait. Lab.; Ind., Plank.
1214. C. parvifolia Ait. Lab.
1215. † C. sanguinea Pal. S. E. K.
1216. C. coccinea L. Lab.; J. City, Panton.
1217. Geum strictum Ait. Ind., Plank.
1218. Rubus strigosus Mx. Red raspberry. Seen by Mr. T. Buckman, Topeka; reported also from Greenwood county.
1219. Spirea tomentosa L. Hardhack. Have a specimen. Reported from Wyandotte county.
1220. Rhexia Virginica L. Deergrass. Cher.
1221. † Ammania Nuttallii. Sal., Henry.
1222. Epilobium coloratum Muhl. Irv., Mrs. J.
1223. Œnothera fruticosa L. S. E. K.; Ind., Plank.; Irv., Mrs. J.
1224. Œ. glauca Mx. S. E. K.; Ind., Plank.
1225. † Œ. bicolor Don. Sal., Henry.
1226. Gaura filipes Spach. Ind., Plank; Irv., Mrs. J.
1227. † G. longifolia. J. City, Panton.
1228. Echinocactus Simpsoni Eng. W. Kansas from Prof. Snow.
1229. Thaspium cordatum Nutt. Leav. Co. from Prof. Snow.
1230. T. barbinode Nutt. Irv., Mrs. J.
1231. Ligusticum actæfolium Mx. Ind., Plank.
1232. Erigenia bulbosa Nutt. Ind., Plank.
1233. † Leptocaulis patens. Sal., Henry.
1234. Cornus florida L. Cher.
1235. C. stolonifera Mx. Lab.
1236. Triosteum angustifolium L. Ind., Plank.
1237. Lonicera flava Sim. Miami; Ind., Plank.
1238. Spermacoce glabra Mx. S. E. K.; Ind., Plank.
1239. Vernonia Nov-Eboracensis Willd. Crawford, Cher., Lab.
1240. V. scaberrima Nutt. Cr., Cher., Lab.
1241. Ageratum conyzoides L. Cher.
1242. Liatris paniculata Willd. One specimen, Topeka.
1243. L. spicata Willd. Linn, Cher.
1244. Eupatorium serotinum Mx. Lab.
1245. E. aromaticum L. Ind., Plank.
1246. Conioselinum cœlestinum DC. Ind., Plank.
1247. Aster concolor L. J. City, Panton.
1248. A. squarrosus Walt. S. E. K.
1249. A turbinellus Lind. S. E. K.
1250. A. dumosus L. S. E. K.
1251. A. mutabilis Ait. S. E. K.
1252. A. nemoralis Ait. S. E. K.
1253. Bellis integrifolia Mx. Ind., Plank.
1254. Solidago latifolia L. S. E. K.
1255. S. discoidea Ell. Lab.
1256. S. stricta Ait. S. E. K.
1257. S. serotina Willd. Douglas.
1258. S. rupestris Raf. S. E. K.

1259. †S. angustata T. & G. S. E. K.
1260. S. radula Nutt. Paola.
1261. S. tortifolia Ell. Cher.
1262. †S. incana. J. City, Panton; G. B., Smyth.
1263. †S. scoparia Wood, n. sp. Plant rigidly erect, 2–4ft., scabrous, canescent, branching above into a simple paniculate corymb. Leaves numerous, small, ovate-lanceolate, 3-veined, sessile, entire, (lowest not seen,) acute, cauline 1′, those on the simple branches 5″–3″–1″. Heads small, subsessile, crowded in cylindrical terminal spikes. Florets about 8, rays minute, achenia glabrous. Pappus of many scabrous white bristles.
1264. †Grindelia! robusta? Scales flat; plant tall. Douglas.
1265. Isopappus divaricatus T. & G. From W. Kansas, Prof. Snow.
1266. Polymnia Canadensis L. Miami.
1267. Silphium trifoliatum L. Doug.; J. City, Panton.
1268. Rudbeckia speciosa Wender. Doug.; Cher.
1269. Helianthus giganteus L. S. E. K.
1270. H. microcephalus T. & G. S. E. K.
1271. †H. Nocoletti T. & G. Lab.
1272. †H. Maximiliani Schrad. var. hybrida Wood. Scales shorter than the disk, and little attenuated like those of H. giganteus. Ramial leaves opposite, cauline alternate; all tripli-veined.
1273. †Actinomeris squarrosa Nutt. var. exaltata Wood. Stem not winged. S. E. K. A species?
1274. Coreopsis verticillata L. Great Bend, from Dr. Oyster.
1275. C. tripteris L. Cher.; Paola.
1276. C. discoidea T. & G. S. E. K.
1277. †Bidens tenuisecta Gr. J. City.
1278. †Flaveria linearis. Great Bend.
1279. Verbesina Siegesbeckii Mx. Ind., Plank.
1280. †Gaillardia pinnatifida Torr. Dodge, from Dr. O.
1281. †Artemisia longifolia Nutt. S. E. K.
1282. Antennaria margaritacea Br. Fontana.
1283. Senecio aureus L. var. balsamitæ. S. E. K.
1284. †Tetradymia! Not in Porter & Coulter. Lab.
1285. *Cirsium arvense Scop. Canada thistle. Lawrence and Topeka.
1286. †C. ochrocentrum Gr. Sal.
1287. Apogon humilis Ell. Irv.
1288. Lactuca graminifolia Mx.? Leaves 6″ wide, 3′ long. A tooth on one side near the base. Seen repeatedly, S. E. K.
1289. Mulgedium acuminatum DC. Linn, Lab.; Ind., Plank.
1290. M. Floridanum DC. Doug.
1291. M. leucophæum DC. G. B., Smyth.
1292. Sonchus oleraceus L. Doug., Fontana; G. B., Smyth.
1293. Lobelia inflata L. Linn.
1294. Specularia Ludoviciana Torr. Miami.
1295. Vaccineum vacillans Poland. Blueberry. Cher.
1296. Ilex decidua Walt. Lab.
1297. Bumelia lanuginosa Pers. Cher.; Ind., Plank.
1398. Anagallis arvensis L. Miami.
1299. Utricularia gibba L. Cher.
1300. Tecoma radicans Juss. Cher., Lab.; Ind., Plank.
1301. *Catalpa bignonioides Walt. Streets.

1302. † Pentstemon Fendleri. G. B.
1303. † P. Brandegei Porter. Lab.
1304. P. digitalis Nutt. Doug.
1305. Gratiola Virginica L. Sal., Henry.
1306. Veronica arvensis L. Lab.
1307. Dasystoma flava Wood. Miami, Lab.
1308. † D. pectinata Torr. From Mr. J. Wilson, Arkansas City.
1309. Gerardia Skinneriana Wood. Cher.
1310. † G. densiflora Boott. J. City, Panton.
1311. Castilleja coccinea Spreng. Cher., Lab.
1312. * Mentha viridis, L. Spearmint. Topeka; Ind., Plank.
1313. Salvia azurea Lam. S. E. K.
1314. Scutellaria canescens Nutt. One specimen, Cher.
1315. Heliophytum Indicum D.C. S. E. K.
1316. Lithospermum arvense L. Linn, Cher.
1317. Mertensia Virginica DC. Paola.
1318. Myosotis palustris Rath. Paola.
1319. † Eretrichium Kansense Wood. n. sp. Sent from Oswego to Prof. Wood by W. S. Newlon, M. D. Description not seen.
1320. Hydrophyllum appendiculatum. Mx. Douglas. Reported to Prof. Snow.
1321. Phacelia hirsuta Nutt. Lab.
1322. † Collomia linearis Nutt. Lab.
1323. Gilia coronopifolia Pers. Ind., Plank.
1324. Batatas macrorhiza Wood. Paola, Oyster.
1325. † Evolvulus sericeus Swtz. G. B., Smyth.
1326. † Bonamia Pickeringii, var. with styles and stigmas like an Ipomea. Prof. Wood thought it a n. sp. of Ipomea.
1327. Solanum sisymbrifolium Lam. Neosho Co.
1328. † S. eleagnifolium. Great Bend.
1329. † Physalis heterophylla Nees. S. E. K.
1330. * Datura tatula L. Roadsides. Dr. Gray inclines to call it a species.
1331. † Withania coronopus Torr. From W. Kansas by Prof. Snow.
† Sabbatia campestris. (See introduction.)
1332. † Eustoma Russellianum. From W. Kansas by Prof. Snow; Great Bend.
1333. Amsonia salicifolia Ph. Allen.
1334. Asclepias variegata L. Ind., Plank.
1335. A. quadrifolia Ph. Ind., Plank.
1336. Fraxinus pubescens Walt. Red ash. Lab.
1337. F. platycarpa Mx. Gray ash. Lab.
1338. F. quadrangulata Mx. Blue ash. Lab.
1339. F. sambucifolia Lam. Black ash. Reported to the Horticultural Society from several counties.
1340. Aristolochia tomentosa Sims. Ind., Plank.
1341. † Oxybaphus hirsutus Ph.? W. Kansas, Prof. Snow.
1342. Eriogonum tomentosum Mx. G. B., Smyth.
1343. Rumex hydrolapathus Huds. var. Americanus Gr. S. E. K.
1344. R. salicifolius Huds. Sal., Henry.
1345. R. sanguineus L. Ind., Plank.
1346. R. hastatulus Baldw. (R. Engelmanni Ledeb.) Doug.
1347. Polygonum sagittatum L. Scratch grass. Cher.
1348. Chenopodium polyspermum L. Linn.
1349. C. urbicum L. Lab.; Ind., Plank.

1350. †Monolepis Nuttalliana. Sal., Henry.
1351. †Atriplex hastata, var. Purshiana. G. B., Smyth.
1352. †A. spicata. G. B., Smyth.
1353. Chenopodina maritima Moq. G. B., Smyth.
1354. Iresine celosioides L. Cher.; G. B., Smyth.
1355. †Frœlichia gracilis Moq. Cher.; Sal., Henry; G. B., Smyth.
1356. †Euphorbia montana Eng. J. City, Panton.
1357. †E. petaloidea Eng. J. City, Panton.
1358. †E. revoluta Eng. J. City, Panton.
1359. E. Geyeri Eng. Lab.
1360. †Tragia nepetæfolia Muller (stylaris of some). J. City.
1361. Ulmus alata Mx. Cork Elm. Reported from the Saline river by Mr. A. D. Bailey, Wa-Keeney.
1362. Celtis Mississippiensis Bosc. Cher.
1363. C. crassifolia. Var. or species of hackberry. S. E. K.
1364. Boehmeria cylindrica Willd. Cher.; Sal., Henry.
1365. Callitriche heterophylla Ph. Sal., Henry.
1366. Carya tomentosa Nutt. Ind., Plank.
1367. Quercus aquatica Mx. Linn, Lab.
1368. Q. lyrata Walt.? Leaves agree. Miami and south.
Betula nigra Ait. Red Birch. Cher.; Ind., Plank. (See introduction.)
1369. Alnus serrulata Willd. Alder. Reported to the Hort. Soc. from several counties.
1370. Salix discolor Muhl. Cher.
1371. S. angustata Ph. Cher.
1372. S. myricoides Muhl. Doug.
1373. S. lucida Muhl. Doug.
1374. Populus angulata Ait. Shawnee.
1375. *P. dilatata Ait. Lombardy poplar. Streets.
1376. *P. alba L. Silver-leaf poplar. Streets.
1377. Acorus calamus L. Sweet Flag. Cher.; Paola.
1378. Potamogeton diversifolius Bart. Cher.
1379. P. lucens L. Irv., Mrs. J.
1380. P. spirillus Tuckm. J. City, Panton.
1381. P. rufescens Schrad. Sal., Henry.
1382. Sagittaria simplex Ph. Ind., Plank.
1383. S. graminea Mx. Sal., Henry.
1384. Smilax hispida Muhl. S. E. K.
1385. S. glauca Walt. S. E. K.
1386. †Erythronium propullanus Gr. J. City, Panton. Buds underground like Podophyllum.
1387. Streptopus amplexifolius DC. Ind., Plank.
1388. Juncus polycephalus Mx. S. E. K.
1389. J. articulatus L. Lab.
1390. J. acuminatus Mx. Lab.; Sal., Henry.
1391. J. Greenii O. & T. Lab.
1392. Commelyna communis L. Lab.
1393. C. erecta L. Miami.
1394. Tradescantia rosea Mx. Ind., Plank.
1395. Cyperus echinatus Ell. Linn.
1396. †C. glomuliferus Schrad. S. E. K.

1397. †C. Carruthii Wood, n. sp. Biennial; culms triquetrous, slender, 6′ high, the leaves longer. Umbel simple, almost capitate. Spikes 4–6-flowered, 2″–3″ long, terete, very acute. Rachis with short, trigonous, winged joints. Allied to C. Michauxianus Schult. S. E. K.
1398. C. Nuttallii Torr. S. E. K.
1399. †C. strigosus var. capitatus Wood. S. E. K.
1400. Killyngia pumila Mx. J. City, Panton.
1401. Eleocharis quadrangulata R. Br. Lab.
1402. E. acicularis R. Br. Salina.
1403. Fimbristylis argentea Vahl. Cher.
1404. Carex gynandra Sch. Lab.
1405. C. Shortiana Dew. Lab.
1406. C. lupulina Muhl. Lab.
1407. C. Woodii Dew. Lab., Miami.
1408. †C. Buxbaumii Wahl. var. turgida Wood. Perigynium almost as broad as long, finally dark brown; orifice sub-entire.
1409. Leersia lenticularis Mx. J. City, Panton.
1410. †Sporobolus montanus. Sal., Henry.
1411. Alopecurus geniculatus L. Sal. Henry. An Alopecurus common in Topeka is only half as tall as A. geniculatus or aristulatus, is glaucous like the latter, and has awns like the former.
1412. Aristida dichotoma Mx. Linn; Cher.
1413. †Muhlenbergia gracilis Gr. Lab.
1414. Paspalum virgatum L. Lab.
1415. P. virgatum var. flexuosum Wood. Stouter. Spikes more and longer. Rachis flexuous. A species? C.
1416. Panicum agrostoides Muhl. Cher.
1417. P. xanthophysum Gr. Doug.
1418. P. latifolium L. Lab.
1419. Oplismenus Walteri. (Panicum.) From Mr. J. Wilson, Arkansas City. Also Linn, Cher.
1420. †Setaria perennis. Between S. viridis and S. glauca. Sal., Henry. Perennial, or biennial from being sown late?
1421. *Phalaris Canariensis L. Escaped from cultivation.
1422. Bromus unioloides H. B. K. Shawnee.
1423. Tricuspis stricta Wood. A fine grass, described only in the Class-Book. Why? Cher.
1424. Bromus ciliatus L. var.? Spikelets only 3–4-flowered. Fontana.
1425. Festuca duriuscula L. Doug.
1426. F. elatior L. Fontana.
1427. †Poa tenuifolia Nutt. Sal., Henry.
1428. Glyceria elongata Trin. Great Bend.
1429. †Elymus sitanion Schult. W. Kansas, Prof. Snow.
1430. Leptochloa filiformis R. & S. Linn.
1431. †Chloris verticillata. Great Bend.
1432. Spartina juncea Willd. Doug.
1433. Andropogon tetrastachys Ell. W. Kansas.
1434. †A. tener. W. Kan.
1435. †Sorghum! Halepense? Panicle white. Cher.
1436. Aspidium acrostichoides Willd. Cher.

1437. Trillium erectum L. Bath flower. Reported from Paola by Prof. Wherrell. Belongs after No. 1385.

Introduced	13
Not east of the Mississippi	71
Number added	389
Whole number	1,437

APPENDIX.

A LIST OF SOME OF THE LARGER FUNGI FOUND IN THE BLUE RIVER VALLEY, BY MRS. E. C. JEWELL.

In the hope of entering into communication with other students of Fungology, I venture to send a brief preliminary report of such fungi as I have been able to identify *positively* as growing in Kansas.

My facilities for such work are limited to a good Wetzler microscope, and a volume of Berkeley's Outlines of British Fungology, which gives no description of microscopic species—with such stray helps as magazine articles, encyclopedias, agricultural reports, etc. I have seen only British works—never even a catalogue of American plants. Of course I have recorded much that I cannot report, for I know of no name for most of my finds. The best naturalists themselves are readjusting their system, since the discovery of the alternate generation of many of the lower orders makes it certain that many plants have had several names apiece allotted to them in the best lists—even Berkeley's. For this reason, I report only the larger ones now.

I would most gladly exchange observations and such tentative knowledge as I possess with any other observer in the same field.

LIST.

AGARICINI.	
Agaricus, species	8+
Coprinus, species	5
Schizophyllum commune	1
POLYPORI.	
Boletus, species	1
Polyporus, sp	6+
HYDNEI.	
Hydnum, sp	1
TREMELINI.	
Hirneola auricula	1
CLAVAREI.	
Clavaria, sp	2
PHALLOIDEI.	
Cynophallus, sp	1
TRICHOGASTERS.	
Geaster, sp	1
Lycoperdon, sp	5
MYXOGASTERS.	
Lycogala, sp	1
NIDULARIACEI.	
Cyathus, sp	1+
PUCCINÆI.	
Puccinia, sp	1+
Ustilago maydis	1
Podisoma	1
ELVELLACEI.	
Marchella, sp	1
Peziza, sp	1

Being 11 orders, 18 genera, and more than 39 species. Of these, only the Puccinia and the Lycogala are minute. I hope to report further hereafter.

TRACES OF THE ABORIGINES IN RILEY COUNTY.

BY PROF. G. H. FAILYER, STATE AGRICULTURAL COLLEGE.

Animated by several rich discoveries in our midst, a few of us of the Agricultural College found time, during the closing weeks of last spring term, to make some examination of the burial mounds and pottery fields in the vicinity of Manhattan. This work was partially under the direction of and by a college organization known as The Scientific Club, and to some extent by individual effort—all, however, by members of the club. I therefore come before you more as a representative of these labors collectively, than of my own actual work. I shall simply present some account of the work in this line without indulging in generalizations; premising that more extended investigations must be made ere we are justified in more than outlining possible hypotheses regarding these ancient inhabitants.

In various portions of Riley county are found abundant evidence of the existence of a people long since departed from their once familiar haunts. These evidences are found in their burial mounds containing implements, utensils and ornaments, and in the sites of their pottery yards and kilns. These shall be described more in detail.

In making some investigations along the track of the tornado of May 30, 1879, which passed near Stockdale, my attention was called to the flint arrow-heads and fragments of pottery which from time to time had been picked up in a field just south of and bordering upon the little town of Stockdale. A few specimens were then collected. Nothing further was done with this until our party of eight, accompanied by Gov. Green, who resides near Stockdale, repaired thither on the 22d day of May, 1880. This field belongs to a Mr. Condray. It covers about forty acres, and has been in cultivation for upwards of twenty years. After each plowing, fragments of pottery with the well-known grass-marks, and variously ornamented, arrow-heads, scrapers, etc., have been picked up. When we visited it, there was a growing crop on the field; but, being corn which was yet small, a pretty fair view of the field could be had. Extensive digging, however, was out of the question. At various places over the field were elevations one to two feet in height. These were evidently the sites of furnaces or other structures where their pottery was burned. The height of these elevations had probably been reduced considerably by the plow. Removing the soil one and a half to two feet in depth, limestone plainly showing the action of fire was found. This, seemingly, was used as the floor of their kilns. Pieces of burned clay, not mixed with sand, and fragments of pottery, were especially abundant about these kilns. It must be borne in mind that pottery and flint implements are scattered all over the field. When the removal of the crop will permit, the club intends to complete the work, making surveys, etc. I have here

specimens obtained in this field. For comparison with those obtained from burial mounds, I invite careful examination of them. From a burial mound near by, containing fragments of very much decayed bones, were obtained a few small pieces of pottery and a few beads and arrow-heads. This mound is on a bluff facing the east. But as this is the general direction of the bluff, it seems no effort was made to secure such position.

Three miles north of Stockdale is another point in which very interesting discoveries were made by Mr. S. C. Mason, a college student. In the center of a large field on the west bank of the Blue river is a slight rise in the surface. But when first occupied it consisted of a square forty feet to the side, and inclosed by a low wall of earth. The mound was opened, and two fire-beds ten feet apart were uncovered at a depth of two feet. These were stone, three feet square, burned quite red, and broken by the heat. All about these fire-beds, and below the depth to which it had been plowed, the soil was mixed with ashes, charcoal, burnt clay, flint chips and fragments of pottery. The charcoal was from three varieties of wood. The diameter of some of the vessels, as determined from the fragments obtained, was nine inches to a foot. This was March 6th, 1880. Two miles from the mouth of Mill creek Mr. Mason found a similar bed, partly washed away by the stream. An hour's work here yielded pottery, flint implements, charcoal, and a wasp's nest burned black; and Mr. Mason thinks it the oldest mud-dauber's nest on record. The specimens before you are from these places.

On the 29th of May last, we opened some mounds one mile east of Manhattan, and on the opposite bluff of the Kansas river, at a sharp angle in the bluff. One of these contained, in addition to the fragments of bones, a few arrow-heads and beads. The other one gave better returns for the labor. There were burials at two levels. The upper portions of the first skeleton reached were so far decayed that only the teeth and small fragments of the skull could be found. These showed the action of fire. The larger bones of the limbs were in such position from the teeth as to indicate a reclining posture. In the position where we judged the head ought to be, several fragments of pottery were to be found. Put together, they form the portion of a vessel before you. Whether this was a true burial urn, I do not assert; but the intricate ornamental figures upon the urn betoken no ordinary vessel.

About one foot below this skeleton, and two feet west of it, was another. It was better preserved, and many of the bones were taken out; but they were fragile and easily broken. This body had been placed in a sitting posture, facing the east or northeast. No arrow-heads, pottery or beads were found about this skeleton.

For more than a year one of our young men, Mr. W. J. Griffing, has been hunting up these burial mounds and opening them. On last Thanksgiving day he invited me to assist him in the further excavation of a mound about three miles west of Manhattan, on a high point of the bluff between

the Kansas river and Wild Cat creek. A rain soon put a stop to our operations. But Mr. Griffing has, at intervals, continued the work, finding many things of interest. At various times these articles have been unearthed at this place. They consist of arrow-heads, rimmers, fleshers, beads of shells and birds' bones, pieces of bone implements, and, perhaps of greater interest, a piece of copper. This appears to have been hammered into shape.

About fifty yards south is a still smaller one. Diligent search has revealed only portions of skeletons. About one dozen of these have been found. Whether this is the site of more recent burials, or whether it is the grave of inferiors, women or slaughtered enemies, I can only conjecture. But, in studying these remains to determine to what manner of people they belonged, we should not lose sight of the seeming relation between these two burial mounds.

On the same bluff, and three-fourths of mile south, is another mound. In this were found articles similar to those in others, but a very large number of beads of birds' bones. This latter and the following were worked up by Mr. Griffing. On a very prominent point about three miles east of Manhattan, Mr. Griffing opened a mound, securing thirty-four arrow-heads, nearly one hundred and fifty shell beads, and over three hundred bone beads. Here are some of the relics from this mound.

The lamented Prof. Mudge and Dr. Blachly, on Nov. 17th, 1879, opened the mound on the summit of Bluemont. This mound, which was formerly supposed to be natural, is the largest of which I have learned. Numerous specimens were obtained by these gentlemen. These heads and flint implements were found. But to these must be added others.

Mr. Griffing, who has done more work in this line in our vicinity than any other one person, dug over the dirt thrown from the mound, and was rewarded by obtaining spear and arrow-heads, a bone fish-hook, etc.

I have here some arrow and spear-heads that were found scattered over the prairie.

A locality which promises rich returns is the Wild Cat bottom, near the college. An abundance of pottery in small pieces has been found. A few days since, I spent an hour there, finding, at one place in the creek bank, and three feet below the present surface, bits of charcoal and pottery. Sinking a hole eighteen inches each way in an elevation in the bottom, three bits of pottery and several pieces of burned clay were taken out. I am confident pottery was made and burned here. The work at this point shall be followed up at the earliest opportunity.

It is not to be understood that all the small mounds in which portions of skeletons are found have contained implements, tools and ornaments. More than half have yielded only portions of skeletons. The locations of these mounds are similar, so far as I have been able to determine. All are on the highest hills. They are at present from six inches to two feet high, and in rare cases four to six feet; are composed of black earth and stones, with sand

at bottom in some cases. The stones are weather-worn, being surface stones. There is always the appearance that the mound is stone-capped; but this has probably resulted from the washing away of the dirt This has probably reduced the height very much.

Several questions are suggested by these discoveries. Prominently among these are, whether the pottery and the mounds were made by the same people. Are all the mounds the work of the same race; or are some more recent? Are any or all of these remains those of the people known further east as Mound Builders? Work in excavating these mounds should be systematic, having in view the answering of these and other questions, and should not be induced by the curiosity of the relic seeker. As yet we have not sufficient data to answer the questions. But a somewhat careful comparison of the collection placed before you has inclined me to believe that some of the mounds, at least, were made by the people living in the bottoms where pottery is now found abundantly.

INDEX.

A.

PAGE.

Adams, F. G., Irrigation in Kansas..... 80
Additions to the list of Kansas Lepidoptera, by Prof. F. H. Snow..... 102

B.

Botanical notes from the Southwest, by B. B. Smyth..... 50
Blachly, Dr. C. P., Ornithology of Riley Co., Kas..... 105
Botanical Addenda for 1879 and 1880, by Prof. J. H. Carruth..... 123

C.

Case, Dr. Theo. S., A Holiday Excursion to the Birth-place of Montezuma..... 13
Color-Blindness and Railway Accidents, by Dr. John Fee..... 30
Cragin, F. W., Preliminary Catalogue of Kansas reptiles and batrachians..... 114
Carruth, Prof. J. H., Botanical Addenda for 1879 and 1880..... 123

D.

Description of a new species of Clerysophanus, by W. W. Edwards..... 69
Descriptions of new species of North American Coleoptera, by Dr. Jno. L. Le Conte, and Dr. Geo. H. Horn..... 74
Douglas County additions to the list of Kansas Coleoptera in 1879 and 1880, by Prof. F. H. Snow..... 78

F.

Fee, John, M. D., Color-Blindness and Railway Accidents..... 30
Failyer, Prof. G. H., Traces of the Aborigines in Riley county..... 132

G.

Great Spirit Spring, by Prof. G. E. Patrick..... 22
Grote, A. R., New Western Noctuidæ..... 63

H.

Holiday Excursion to the Birth-place of Montezuma, by Dr. Theo. S. Case..... 13
Hilton, H. R., Rainfall in its relation to Kansas Farming..... 39
Horn, Dr. Geo. H., Descriptions of new species of North American Coleoptera..... 74

I.

Irrigation in Kansas, by F. G. Adams..... 80

J.

Jewell, Mrs. E. C., List of some of the larger fungi found in the Blue River valley..... 131

K.

Kansas Weather Service, by Prof. J. T. Lovewell..... 86

L.

List of Lepidoptera, by Prof. F. H. Snow..... 61

PAGE.

List of Coleoptera, Santa Fé Cañon, by Prof. F. H. Snow..... 70
Le Conte, Dr. Jno. L., descriptions of new species of North American Coleoptera..... 74
Lovewell, Prof. J. T., Kansas Weather Service, 86
List of some of some of the larger Fungi found in the Blue River valley, by Mrs. E. C. Jewell..... 131

M.

Memorial of Prof. Benj. F. Mudge..... 7
Metamorphic Deposit in Woodson county, by Prof. Mudge..... 12
Mudge, Prof. B. F., List of Minerals found in Kansas..... 27
Metamorphic Deposit in Woodson county..... 12
Magnetic Declination in Kansas, for October, 1880, by Prof. H. S. S. Smith..... 48
Meteorological Summary for 1878, 1879, 1880, by Prof. F. H. Snow..... 89

N.

New Western Noctuidæ, by A. R. Grote..... 63

O.

Ornithology of Riley county, Kas., by Dr. C. P. Blachly..... 105

P.

Parker, Prof. J. D., Memorial of Prof. Mudge.. 7
Patrick, Prof. G. E., The Great Spirit Spring... 22
Popenoe, Prof. E. A., Report of Proceedings... 3
Preliminary List of the Hymenoptera of Kansas, by Prof. F. H. Snow..... 97
Preliminary Catalogue of Kansas Reptiles and Batrachians, by F. W. Cragin..... 114

R.

Report Twelfth Annual Meeting..... 3
Thirteenth Annual Meeting..... 4
Rainfall in relation to Kansas Farming, by H. R. Hilton..... 39

S.

Secretary's Report..... 3
Savage, Joseph, Sink Holes in Wabaunsee Co.. 28
Stone Implements in Trego county..... 80
Smith, Prof. H. S. S., Magnetic Declination in Kansas, for October, 1880..... 48
Smyth, B. B., Botanical Notes from the Southwest..... 50
Snow, Prof. F. H., List of Lepidoptera, Idaho Springs, Colorado..... 61
List of Coleoptera, Santa Fé Cañon, N. M..... 70
Douglas County additions to the list of Kansas Coleoptera in 1879 and 1880..... 78
Meteorological Summary for 1878, 1879, 1880... 89
Preliminary list of the Hymenoptera of Kansas..... 97
Additions to the list of Kansas Lepidoptera.... 102

T.

Traces of the Aborigines in Riley county, by Prof. G. H. Failyer..... 132

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